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AN INVESTIGATION OF STREAMWISE BODY-FIN GAPS AS A MEANS OF ALLE--ETC(U)
JAN 77 J H HENDERSON

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TECHNICAL REPORT RD-77-13

AN INVESTIGATION OF STREAMWISE BODY-FIN GAPS AS A MEANS OF ALLEVIATING THE ADVERSE PLUME EFFECTS ON MISSILE LONGITUDINAL STABILITY

Aeroballistics Directorate
US Army Missile Research, Development and Engineering Laboratory
US Army Missile Command
Redstone Arsenal, Alabama 35809

January 1977

U.S. ARMY MISSILE COMMAND
Redstone Arsenal, Alabama

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Thrust Effects
Longitudinal Stability
Plume Effects
Base Pressure
Jet Plume
Gap Effects

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Transonic wind tunnel tests were conducted on a body of revolution with various fin configurations to investigate jet plume effects on missile longitudinal stability. The sting-mounted model utilized a series of cold air normal jets located downstream of the base to simulate the jet plume. Fins of various planform geometry were tested in three longitudinal positions. Present report compares one fin planform with and without a 5 percent body diameter gap. Gap results in a small reduction of adverse plume effects for fins in aft

next Page

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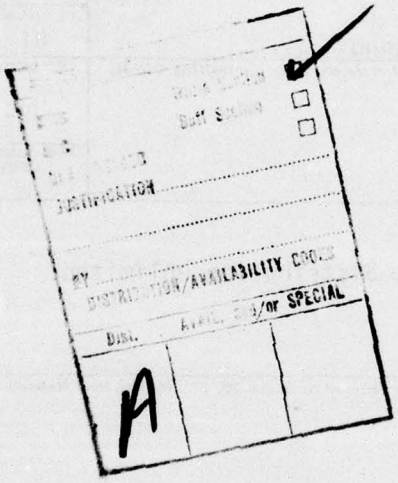
20. ABSTRACT (Concluded)

position. Data for this investigation were obtained from Calspan test CAL T17-123.



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EFFECT OF GAP ON FIN NORMAL FORCE AT VARIOUS THRUST	GAP MACH FIN POSITION PHI	(D)	46-60

PLOT SCHEDULE:

(A) C_N VERSUS α

(B) $C_{N_{F2}}$ VERSUS α

(C) C_{N_α} VERSUS C_{R_T}

(D) $C_{N_{\alpha_{F2}}}$ VERSUS C_{R_T}

INTRODUCTION

During the past few years, the Army Missile Command has been interested in the adverse effects of the propulsive jet plume on missile aerodynamics (see reference 1). Of particular importance are the effects on missile longitudinal stability. Wind tunnel investigations have been conducted to determine effect of thrust level on missile longitudinal stability and to assess the effectiveness of locating fins some distance forward of the base to alleviate adverse effects on stability (see references 2, 3, and 4). Results of these tests indicated that fin effectiveness (when affected by the plume) improved as the distance from the base was increased.

One of the fin planforms tested in reference 4 (F2) was also tested with a five percent of body diameter longitudinal gap at the fin-body juncture (F4). It was expected that the gap would reduce the two-dimensional flow effects at this juncture and alleviate the adverse plume effects on missile stability. Reference 4 presents results. In the present report, data for the F2 and F4 configurations are compared directly. Data at angles of attack higher than four degrees are excluded.

Past tests (for example, reference 6) have shown that gaps cause a loss in fin effectiveness. This loss is caused by a partial cancellation of the fin-body interference lift. The purpose of the test of reference 6 was to investigate the feasibility of using gaps to reduce the large increase in stability margin of rockets which occurs at transonic speeds. The reduction in transonic stability is one of the means of reducing rocket

wind sensitivity during boost. Some typical results from reference 6 are compared with present results.

APPARATUS AND TESTS

These tests were described in detail in references 4 and 5. Briefly the sting-mounted model, which had a 6-component strain gage balance, was 52 inches in length and 5 inches in diameter. It had a 3-caliber tangent ogive nose and a cylindrical body. The model was tested in combination with cruciform rectangular fins; each fin panel had a 3-component strain gage balance.

Plume simulator consisted of 24 normal sonic jets arranged circumferentially in two rows with a common air chamber. The simulator was located 2.5 inches aft of the base. The combined exit area of the 24 jets represented six percent of the model base (reference area).

Fin nomenclature is as follows:

F2 (BF2)--fins with 3-inch chord and 2.5-inch semi-span.

F4 (BF4)--fins with 3-inch chord, 2.5-inch semi-span, and a .25-inch gap between the fuselage and the root chord.

Fin positions are as follows:

Aft--fin trailing edge flush with model base (M.S. 52.000, 0 cal.)
--fin hinge line at M.S. 49.750

Mid--fin trailing edge 3.75 inches from base (M.S. 48.250, 0.75 cal.)
--fin hinge line at M.S. 46.000

Fwd--fin trailing edge 7.5 inches from base (M.S. 44.500, 1.5 cal.)
--fin hinge line at M.S. 42.250

Model installation is shown in figure 3. A description of the geometry for fins F2 and F4 is shown in figure 4.

TEST CONDITIONS

The test was conducted in the Calspan Corporation 8-foot Transonic Wind Tunnel. A detailed description of this facility is presented in reference 5. Test Mach numbers ranged from 0.4 to 1.25. The amount of air in the tunnel circuit was equivalent to a wind-off static pressure of 0.5 atmosphere. Plume effect, or value of C_{R_T}, was varied by changing simulator chamber pressure P_C. Normally, angle of attack is varied during a run and configuration, C_{R_T}, and tunnel operating conditions are kept constant. Air was supplied to the plume simulator at flow rates up to 15 pounds per second and at chamber pressures to 600 psi. Angles of attack were varied from -4 to 12 degrees.

Model aerodynamic data were resolved in the body axis system with the origin located at model station 26.5 on the model centerline. Aerodynamic data from the tail fin balances were resolved in individual axis systems; origins were located at the intersection of the tail fin lines and the balance centerlines.

PLUME SIMULATION

Base pressure ratio P_b/P_∞ is a good measure of plume effects on missile aerodynamics (see reference 1). One of the parameters convenient to use with base pressure is thrust coefficient C_T, where C_T is axial thrust non-dimensionalized by dynamic pressure and body cross sectional area S. For the normal jet simulator, a similar parameter is radial thrust coef-

ficient C_{R_T}, where

$$C_{R_T} = \frac{\text{radial thrust}}{qS}$$

For an axial jet, base pressure appears to be primarily influenced by the portion of the jet plume in the vicinity where the jet boundary interacts with the freestream flow. Where C_T can be considered to represent the axial component of the effective jet, it can be assumed that C_{R_T} represents the normal component.

For the plume size of interest in the current investigation, a value of C_T several times the value of C_{R_T} is required for matching base pressures. The exact C_T/C_{R_T} ratio will depend on a comparison of flight base pressures with base pressure value for the normal jet simulator.

RESULTS AND DISCUSSION

Plotted data consist of comparisons between BF2 and BF4 total normal forces, C_N, and fin no. 2 panel normal forces, $C_{N_{F2}}$, for various levels of simulated thrust. Matching runs for BF2 and BF4 were made from Mach 0.7 to 1.2 for zero roll position and from Mach 0.9 to 1.2 for a roll of 45 degrees. Panel normal force is presented for fin no. 2 only.

Inspection of the plots of C_N and $C_{N_{F2}}$ versus angle of attack generally shows a small but definite effect of the gap. A better overall view of gap effects may be obtained from plots of C_{N_α} and $C_{N_{\alpha F2}}$ versus C_{R_T} with no plume effects ($C_{R_T} \leq .1$). As expected, a small decrement is apparent.

Values of C_N for fins in the aft position are compared with data of reference 6 in figure 5. In this comparison, body alone C_N was subtracted from the present data since afterbody forces only were measured in reference 6. Model geometry of reference 6 is shown in figures 6 and 7. Although geometry and gap size differ between the two tests, the gap effects for small gaps is about the same.

With plume effects, there is a small but definite improvement in C_{N_α} and $C_{N_{\alpha F2}}$ with fins in the aft position. With fins in the mid position, most of the decrement in C_{N_α} without plume effects is canceled when there are plume effects. There appears to be no change with plume effects due to the gap with fins in the forward position.

For fins in the aft position, it is possible for a larger gap size to result in a significant reduction in adverse plume effects on fin effectiveness. In cases where missile design considerations force the use of aft fins, it may be profitable to investigate gap and fin geometries.

REFERENCES

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6. Dahlke, C. W., and Pettis, W., Normal Force Effectiveness of Several Fin Planforms with Streamwise Gaps at Mach Numbers of 0.8 to 5.0. Technical Report RD-TR-70-8, April 1970, U. S. Army Missile Command, Redstone Arsenal, Ala.

NOMENCLATURE

SYMBOL	MNENOMIC	DEFINITION
RN/L	RN/L	unit Reynolds number; per ft
V		velocity; ft/sec
α	ALPHA	angle of attack, degrees
β	BETA	angle of sideslip, degrees
ψ	PSI	angle of yaw, degrees
ϕ	PHI	angle of roll, degrees
ρ		mass density; slugs/ft^3

Reference & C.G. Definitions

A_b		base area; m^2, in^2
b, b_{ref}	BREF	wing span or reference span; m, in
c.g.		center of gravity
ℓ_{REF}, $\bar{c}$	LREF	reference length or wing mean aerodynamic chord; m, in
P_c		simulator chamber pressure
S, S_{ref}	SREF	reference area based on body diameter, in^2
	MRP	moment reference point
	XMRP	moment reference point on X axis
	YMRP	moment reference point on Y axis
	ZMRP	moment reference point on Z axis

NOMENCLATURE (Continued)

SYMBOL	MNEMONIC	DEFINITION
		Body Axis System
C_N	CN	normal force coefficient; F_N/qS
C_A	CA	axial force coefficient; F_A/qS
C_{A_b}	CAB	base axial force coefficient; $(-1) \cdot [(p_b - p_\infty)/q] (A_b/S)$
C_{A_u}	CAU	uncorrected axial force coefficient
C_m	CLM	pitching moment coefficient; $M_Y/qS\ \ell_{ref}$
C_y	CY	side force coefficient; F_Y/qS
C_n	CYN	yawing moment coefficient; $M_Z/qS\ b_{ref}$
C_ℓ	CBL	rolling moment coefficient; $M_X/qS\ b_{ref}$
$C_{N_{TX}}$	CNTX	fin normal force coefficient for fin number X $\frac{\text{Fin Normal Force}}{qS}$
$C_{N_{FX}}$	CNFX	fin number X corrected normal force coefficient, CNF1 = CNT1 CNF2 = CNT2 CNF3 = (-1.0) CNT3 CNF4 = (-1.0) CNT4
$C_{HM_{FX}}$	CLMHX	fin hinge moment coefficient, $\frac{\text{Fin Hinge Moment}}{qS\ \ell_{ref}}$
$C_{BM_{FX}}$	CLMRX	root bending moment coefficient, $\frac{\text{Fin Root Bending Moment}}{qS\ \ell_{ref}}$

NOMENCLATURE (Continued)

SYMBOL	MNENONIC	DEFINITION
	CPB1	base pressure coefficient at tap 1
	CPB2	base pressure coefficient at tap 2
	CPC	cavity pressure coefficient
	CPXT1	tail fin number 1 center of pressure location
	CPYT1	tail fin number 1 lateral center of pressure location
C_T	CT	thrust coefficient, axial thrust/qS
C_{R_T}	CRT	radial thrust coefficient, radial thrust/qS
C_{N_α}	CNA	normal force coefficient derivative with respect to angle of attack
$C_{N_{\alpha_{FX}}}$	CNAFX	fin normal force coefficient derivative with respect to angle of attack
P_{b1}/P_∞	PB1/P	base pressure tap 1 ratio to freestream pressure
P_{b2}/P_∞	PB2/P	base pressure tap 2 ratio to freestream pressure
$\frac{(P_{b1}/P_\infty+P_{b2}/P_\infty)}{2}$	PB-AVG	average of two base pressure tap ratios
Fin Position	FINPOS	fin position on body; defined on page 6
	PL	air supply pressure upstream of orifice, psi
	WA	air supply flow rate, lb/sec
C_{m_α}		pitching moment coefficient derivative with respect to angle of attack

NOMENCLATURE (Concluded)

SYMBOL	MNEMONIC	DEFINITION
a		speed of sound; ft/sec
C_p	CP	pressure coefficient; $(p_l - p_\infty)/q$
M	MACH	Mach number; V/a
p		pressure; psf
q	Q(NSM Q(PSF)	dynamic pressure; $1/2\rho V^2$
F_N		normal force
F_A		axial force
M_Y		pitching moment
F_Y		side force
M_Z		yawing moment
M_X		rolling moment
GAP	GAP	distance between fuselage and fin root chord, in.

SUBSCRIPTS

b	base
l	local
s	static conditions
t	total conditions
∞	free stream

TEST: CAL T17-123

DATA SET/RUN NUMBER COLLATION SUMMARY

DATE: 06-13-74

DATA SET IDENTIFIER	CONFIGURATION	SCHD. α	SCHD. β	PARAMETERS/VALUES φ	F.P.	MACH	NO. OF RUNS	CRT (OR ALTERNATE INDEPENDENT VARIABLE) 0	2.5	4.2	6.0	7.2	8.5	10.3	12.0	20	37.5	TEST RUN NUMBERS
RX8Δ *67	BF2	A	0	0	1	0.7	5	273			271			270				
68						0.9	5	266			268		267					
69						1.0	6	265		258	257							
70						1.2	5	264		262	261							
45					2	0.7	5	166			164			163				
46						0.9	4	170			168		167					
47						1.0	5	174		175	172							
48						1.2	5	180		178	177							
13					3	.7		48			50			51				
14						0.9	4	47			45		44					
15						1.0	5	43		41	40							
16						1.2	4	38		36	35							
17				45		0.9	2	58			53							
18				45		1.0	2	57			54							
19				45		1.2	2	56			55							

* Δ=0 DATA	CN	CLM	CNT1	CNT2	CNT3	CNT4	PB1/P	PB2/P	CA	CRT ALPHA 9
Δ=1 DATA	CY	CYN	CBL	PL	WA					CRT ALPHA 5
Δ=2 DATA	CLMH1	CLMH2	CLMH3	CLMH4	CLMR1	CLMR2	CLMR3	CLMR4	CPXT1 CPYT1	CRT ALPHA 10

TYPE OF DATA α OR β SCHEDULES

COEFFICIENT SCHEDULES

αA=-4, -2, -1, -1/2, 0, 1/2, 1, 2, 4

αB=-4, -2, -1, -1/2, 0, 1/2, 2, 3, 4, 6, 8, 10, 12

IDVAR(1) IDVAR(2) NDV

F.P. = FIN POSITION CODE: 1 = AFT, 2 = MID, 3 = FWD

TEST: CAL T17-123 — **DATA SET/RUN NUMBER COLLATION SUMMARY** — **DATE: 06-13-74**

DATA SET IDENTIFIER	CONFIGURATION	SCHD. α	SCHD. β	PARAMETERS/VALUES φ	F.P.	MACH	NO. OF RUNS	(OR ALTERNATE INDEPENDENT VARIABLE) 0	2.5	4.2	6.0	7.2	8.5	10.3	12.0	20	37.5	TEST RUN NUMBERS
RX8Δ*63	BF4	A	0	0	1	0.7	3	251			250			249				
64	↓	↓	↓	↓	↓	0.9	3	246			247		248					
65						1.0	3	245		244	243							
66					↓	1.2	3	240		241	242							
25					3	0.7	3	96			94			95				
26					↓	0.9	3	105			104		103					
27						1.0	3	100		102	101							
28				↓		1.2	3	99		98	97							
29				45		0.9	2	109			108							
30				↓		1.0	2	110			107							
31				↓	↓	1.2	2	111			106							
49				0	2	0.7	3	213			214			215				
50				↓	↓	0.9	3	212			211		210					
51						1.0	3	209		208	207							
↓ 52	↓	↓	↓	↓	↓	1.2	3	206		205	204							

* Δ=0 DATA, CN, CLM, CNT1, CNT2, CNT3, CNT4, PB1/P, PB2/P, CA, CRT, ALPHA, 9

Δ=1 DATA, CY, CYN, CBL, PL, WA, CRT, ALPHA, 5

Δ=2 DATA, CLMH1, CLMH2, CLMH3, CLMH4, CLMR1, CLMR2, CLMR3, CLMR4, CPXT1, CPYT1, CRT, ALPHA, 10

TYPE OF DATA α OR β SCHEDULES

COEFFICIENT SCHEDULES

αA=-4, -2, -1, -1/2, 0, 1/2, 1, 2, 4

αB=-4, -2, -1, -1/2, 0, 1/2, 2, 3, 4, 6, 8, 10, 12

IDVAR(1) IDVAR(2) NDV

F.P. = FIN POSITION CODE: 1 = AFT, 2 = MID, 3 = FWD

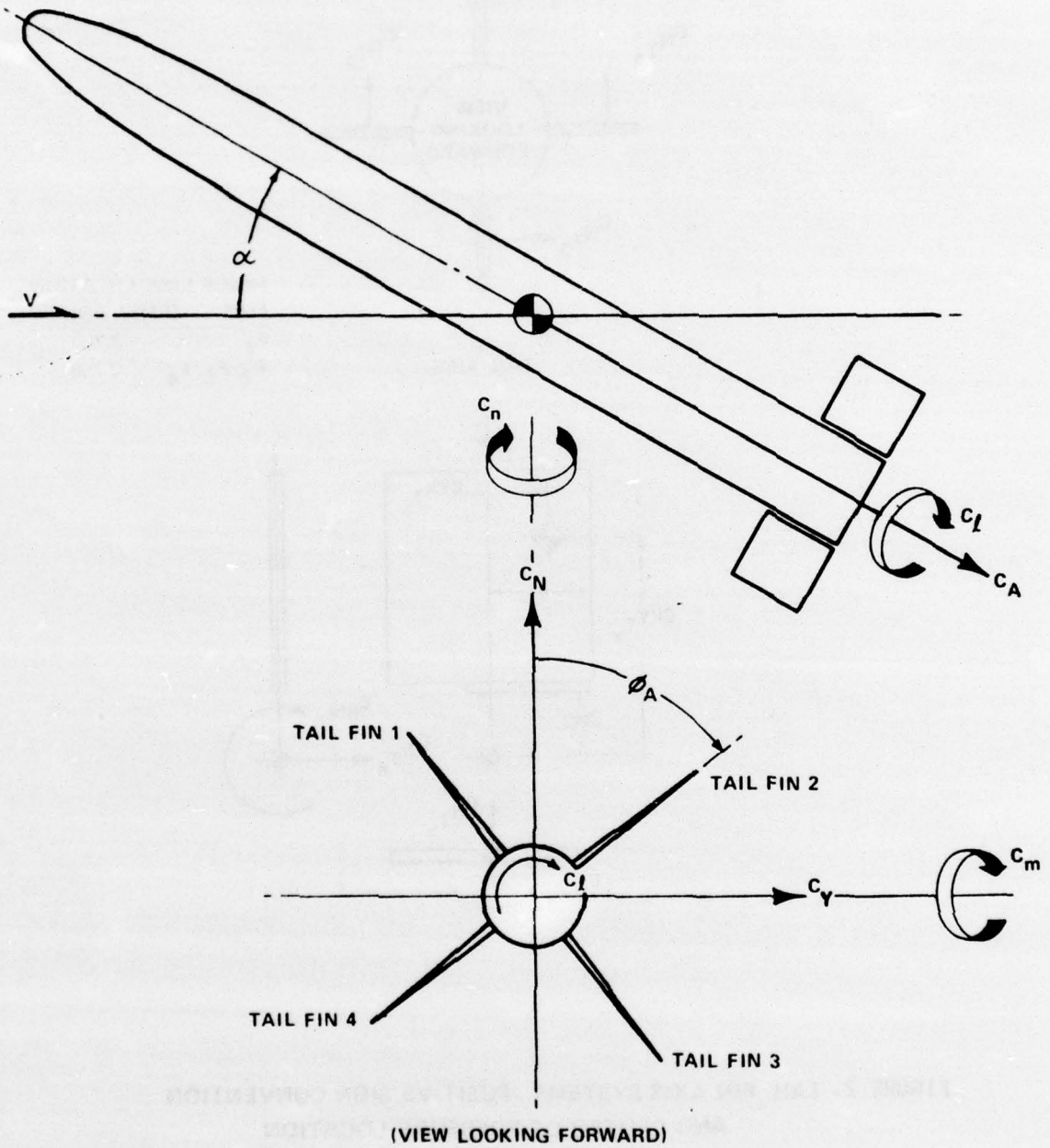
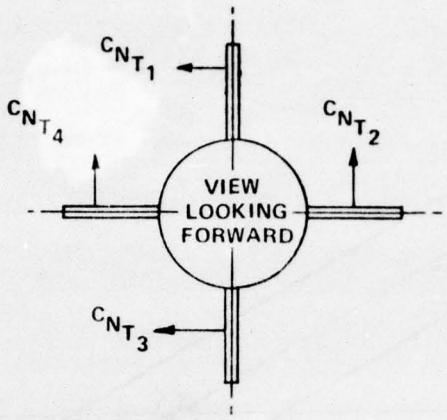


FIGURE 1. AXIS SYSTEMS AND POSITIVE SIGN CONVENTION, BODY AXIS SYSTEM



TAIL FINS

HINGE LINE LOCATION	
FINS	DIMENSION "a"
F_1	2.750
F_2, F_3, F_4	0.750

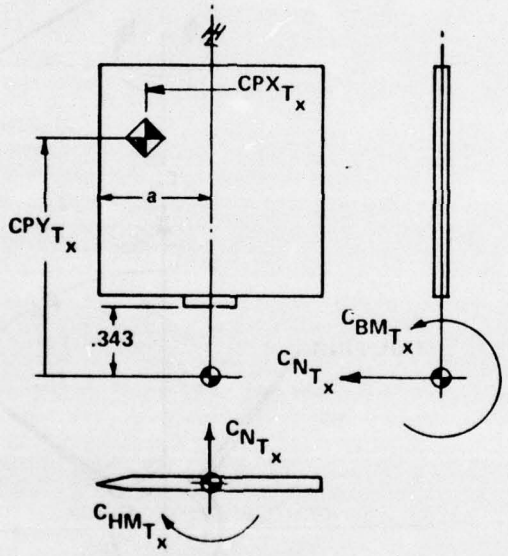


FIGURE 2. TAIL FIN AXIS SYSTEMS , POSITIVE SIGN CONVENTION AND CENTER OF PRESSURE LOCATION

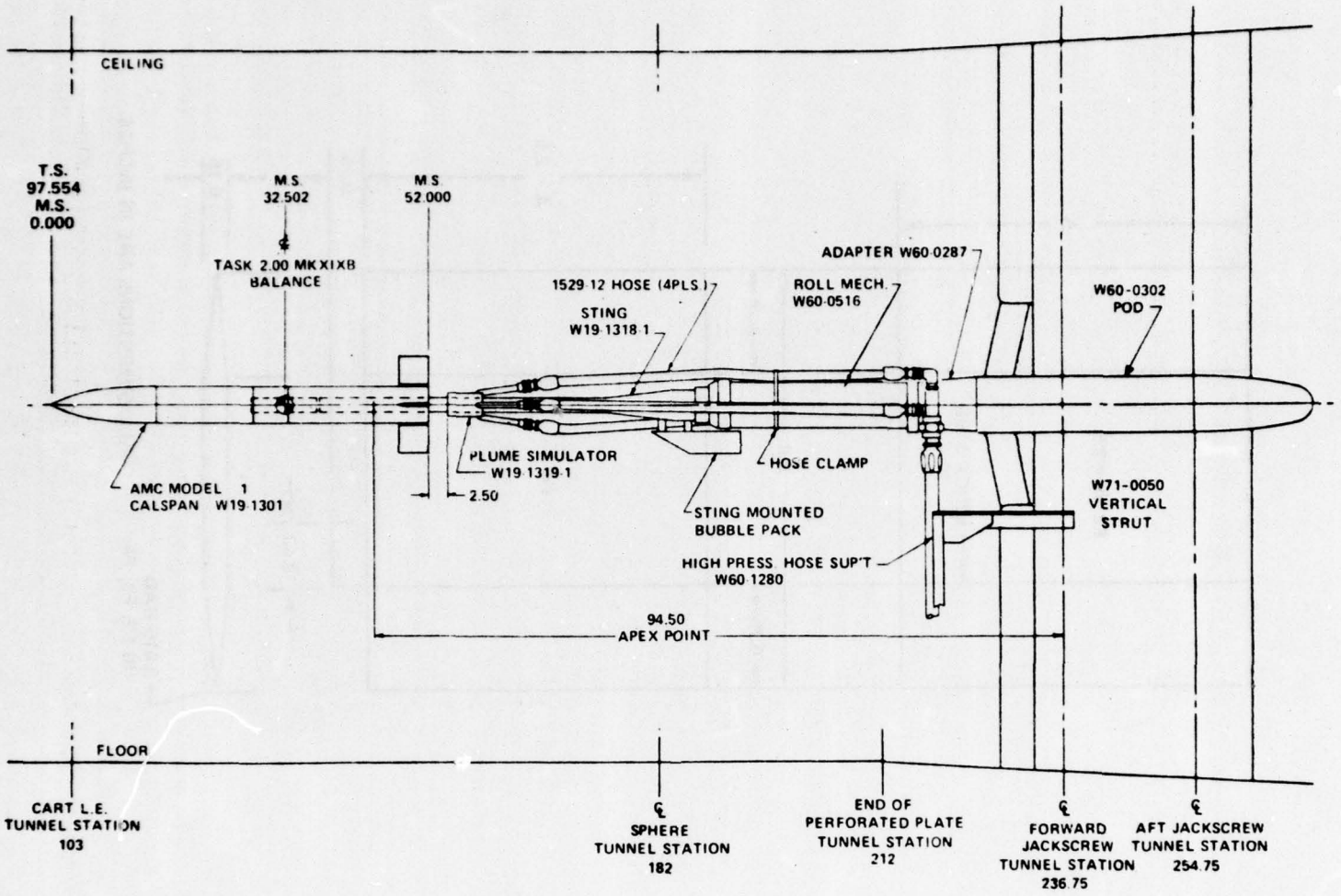


FIGURE 3. INSTALLATION DRAWING

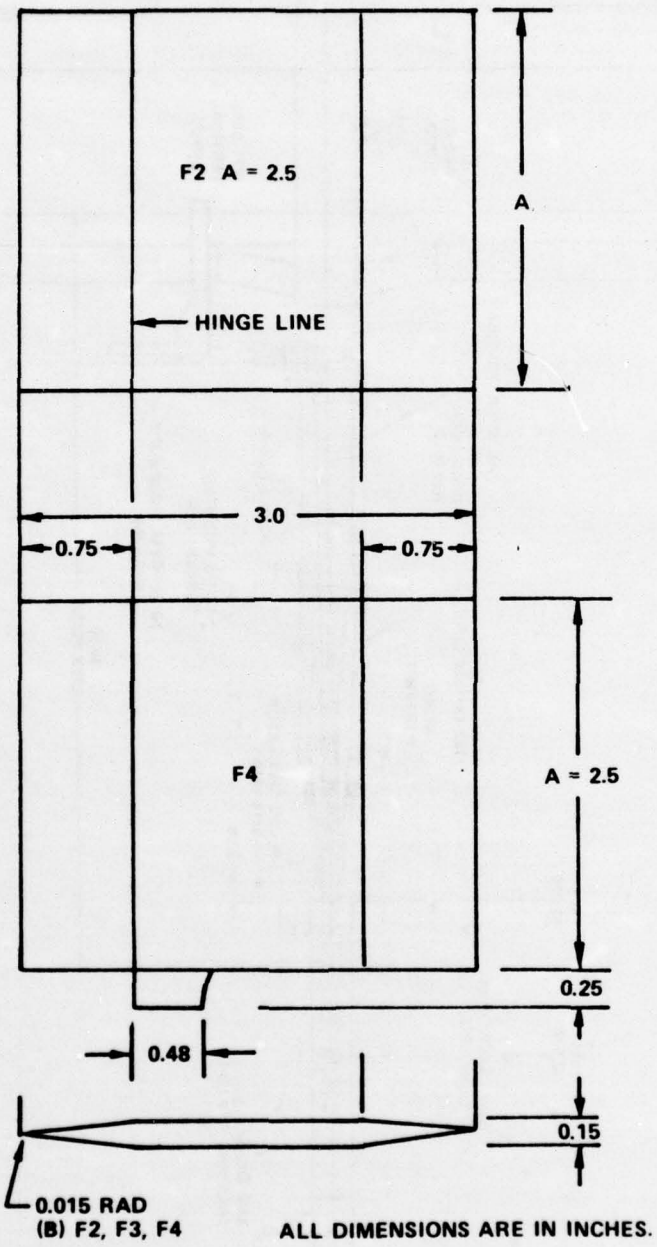


FIGURE 4. GEOMETRY OF FINS F2 AND F4

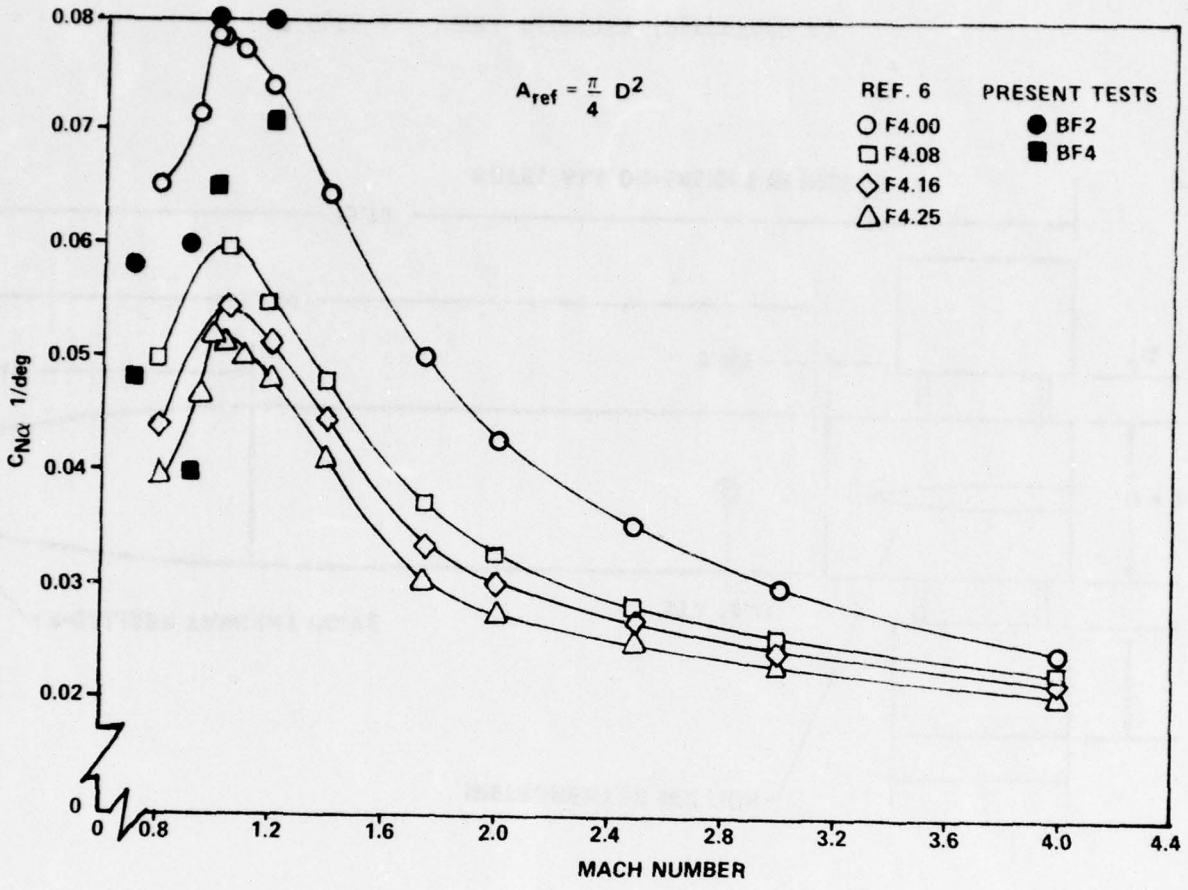


FIGURE 5. NORMAL FORCE COEFFICIENT SLOPE VERSUS MACH NUMBER

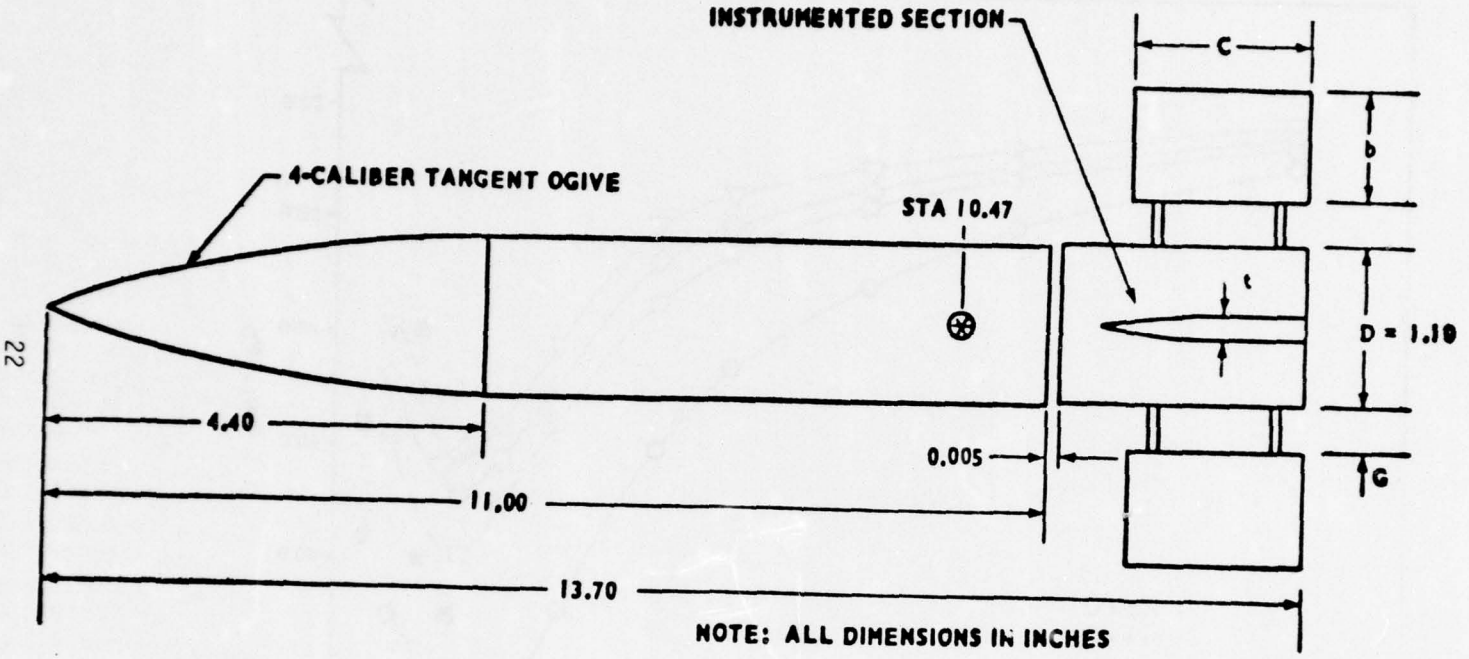
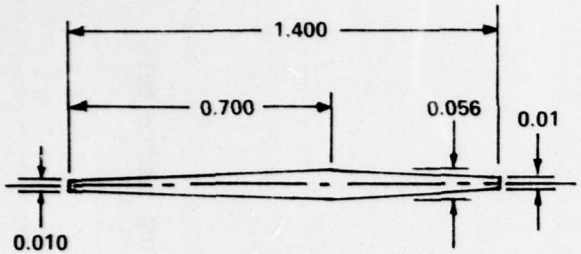
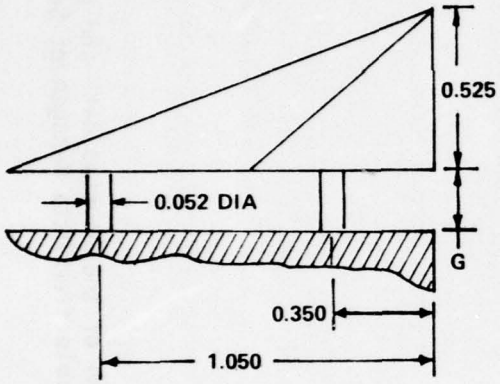
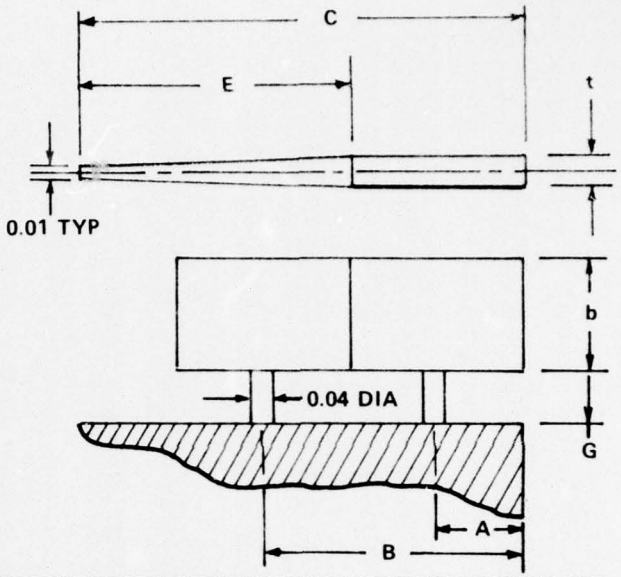


FIGURE 6. MODEL GEOMETRY (REFERENCE 6)





CONFIGURATION	G
FD.00	0
FD.06	0.066
FD.12	0.132
FD.20	0.220



CONFIGURATION	C	b	t	G	A	B	E
F4.00 F4.08 F4.16 F4.25	0.942	0.471	0.063	0 0.088 0.176 0.275	0.242	0.706	0.520
F7.00 F7.06 F7.12 F7.20	1.400	0.525	0.056	0 0.066 0.132 0.220	0.350	1.050	0.350
F8.00 F8.06 F8.12 F8.20	1.400	0.350	0.056	0 0.066 0.132 0.220	0.350	1.050	0.350

FIGURE 7. FIN GEOMETRY (REFERENCE 6)

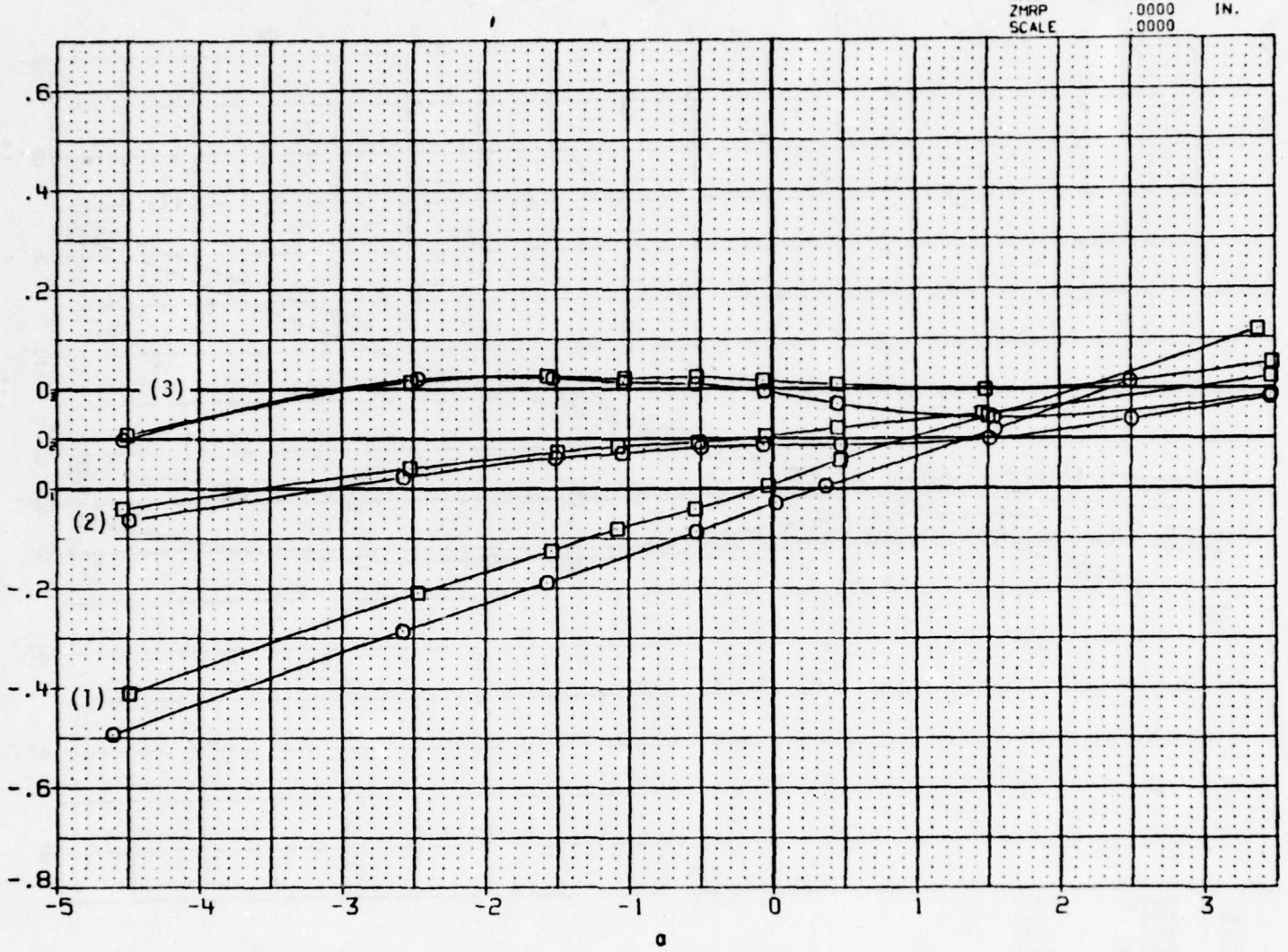
PLOTTED DATA

Tabulations of the plotted data and corresponding source data are available from Data Management Services.

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(EX8067)	○	CAL T17-123 (BF2) BODY, FIN IN AFT POSITION	.000	.700	.000
(DX8063)	□	CAL T17-123 (BF4) BODY, FIN IN AFT POSITION	.250	.700	.000

REFERENCE INFORMATION

SREF	19.6350	SQ. IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	

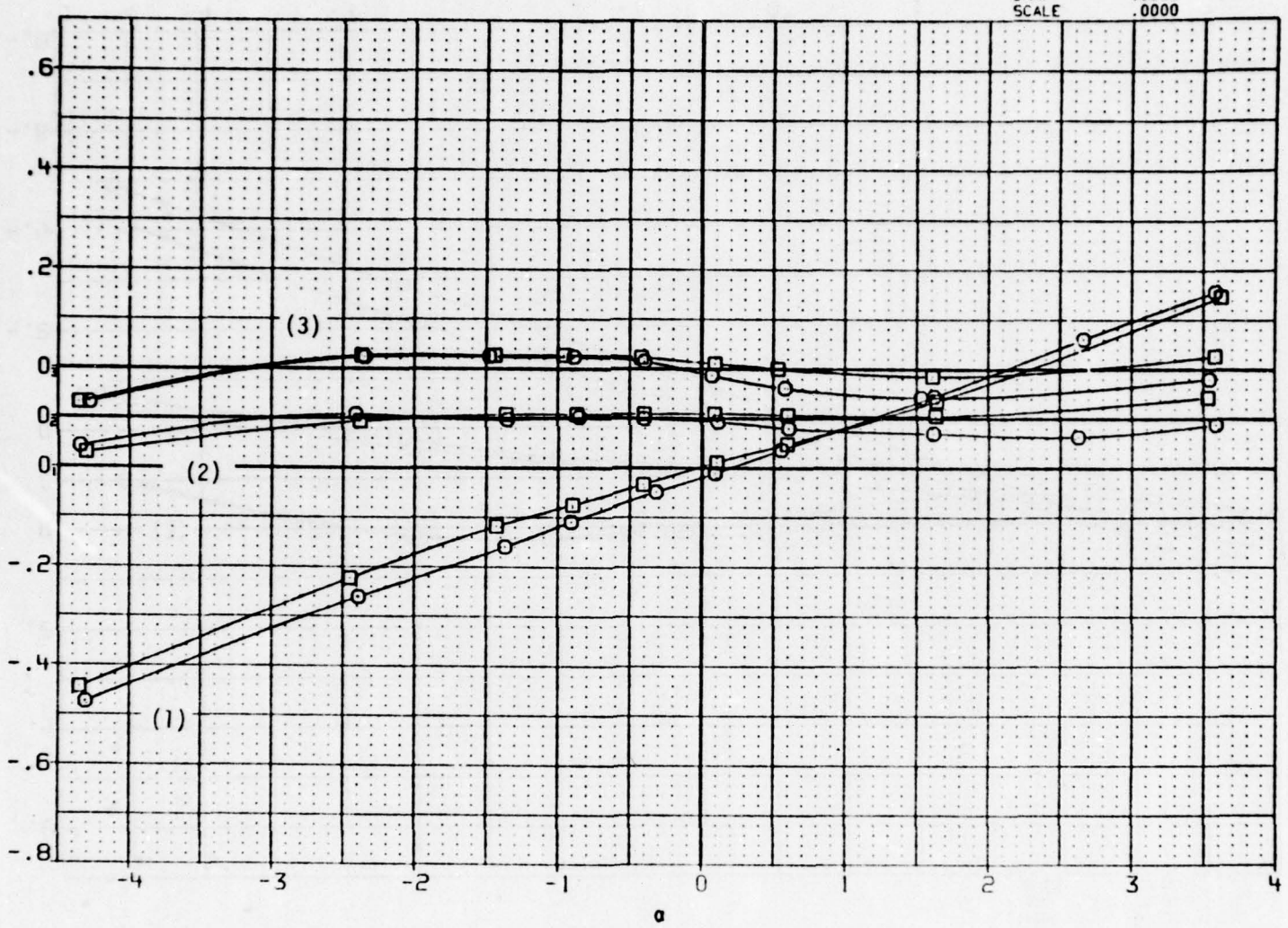


EFFECT OF GAP ON NORMAL FORCE AT VARIOUS THRUST LEVELS

(1) CRT = .03 (2) 5.79 (3) 10.53

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(EX8068)	○	CAL T17-123 (BF2) BODY, FIN IN AFT POSITION	.000	.900	.000
(DX8064)	□	CAL T17-123 (BF4) BODY, FIN IN AFT POSITION	.250	.900	.000

REFERENCE INFORMATION		
SREF	19.6350	SQ. IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	



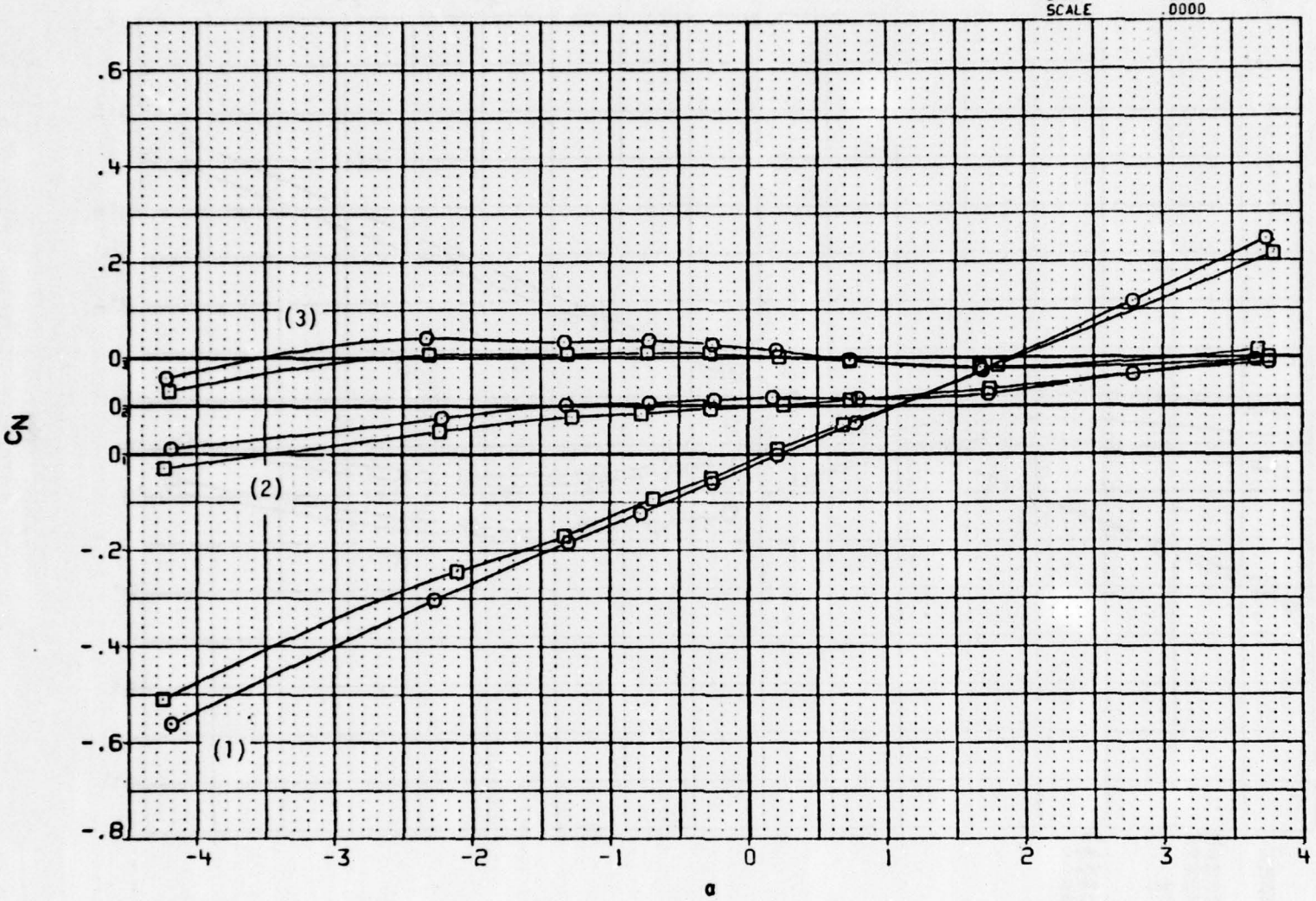
EFFECT OF GAP ON NORMAL FORCE AT VARIOUS THRUST LEVELS

(1) CRT = .03 (2) 5.72 (3) 8.76

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(EX8069)	○	CAL T17-123 (BF2) BODY, FIN IN AFT POSITION	.000	1.000	.000
(DX8065)	□	CAL T17-123 (BF4) BODY, FIN IN AFT POSITION	.250	1.000	.000

REFERENCE INFORMATION

SREF	19.6350	SQ. IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	

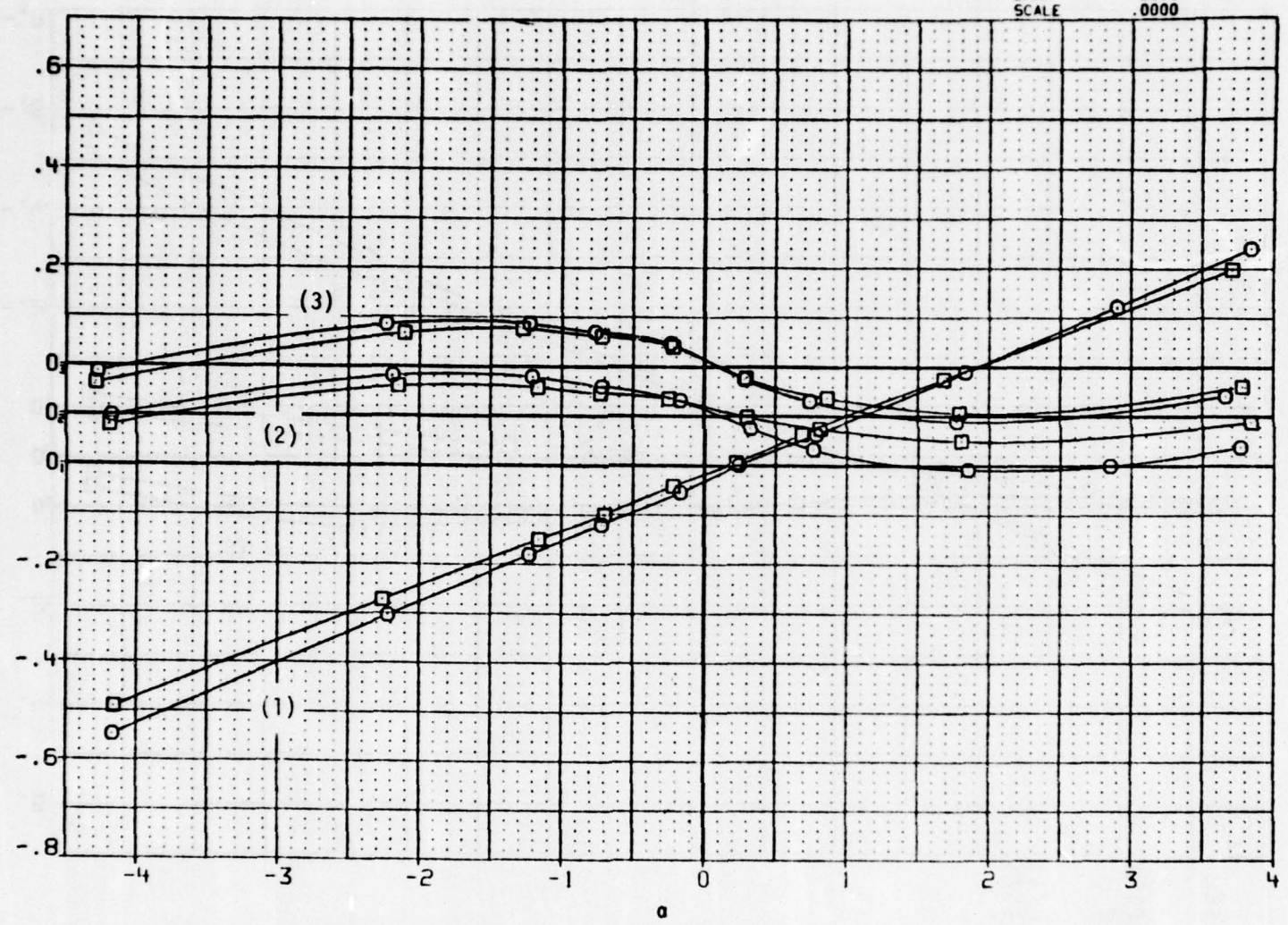


EFFECT OF GAP ON NORMAL FORCE AT VARIOUS THRUST LEVELS

(1) CRT = .02 (2) 4.04 (3) 6.06

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(EX8070)	○	CAL T17-123 (BF2) BODY, FIN IN AFT POSITION	.000	1.200	.000
(DX8086)	□	CAL T17-123 (BF4) BODY, FIN IN AFT POSITION	.250	1.200	.000

REFERENCE INFORMATION		
SREF	19.6350	SQ. IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	



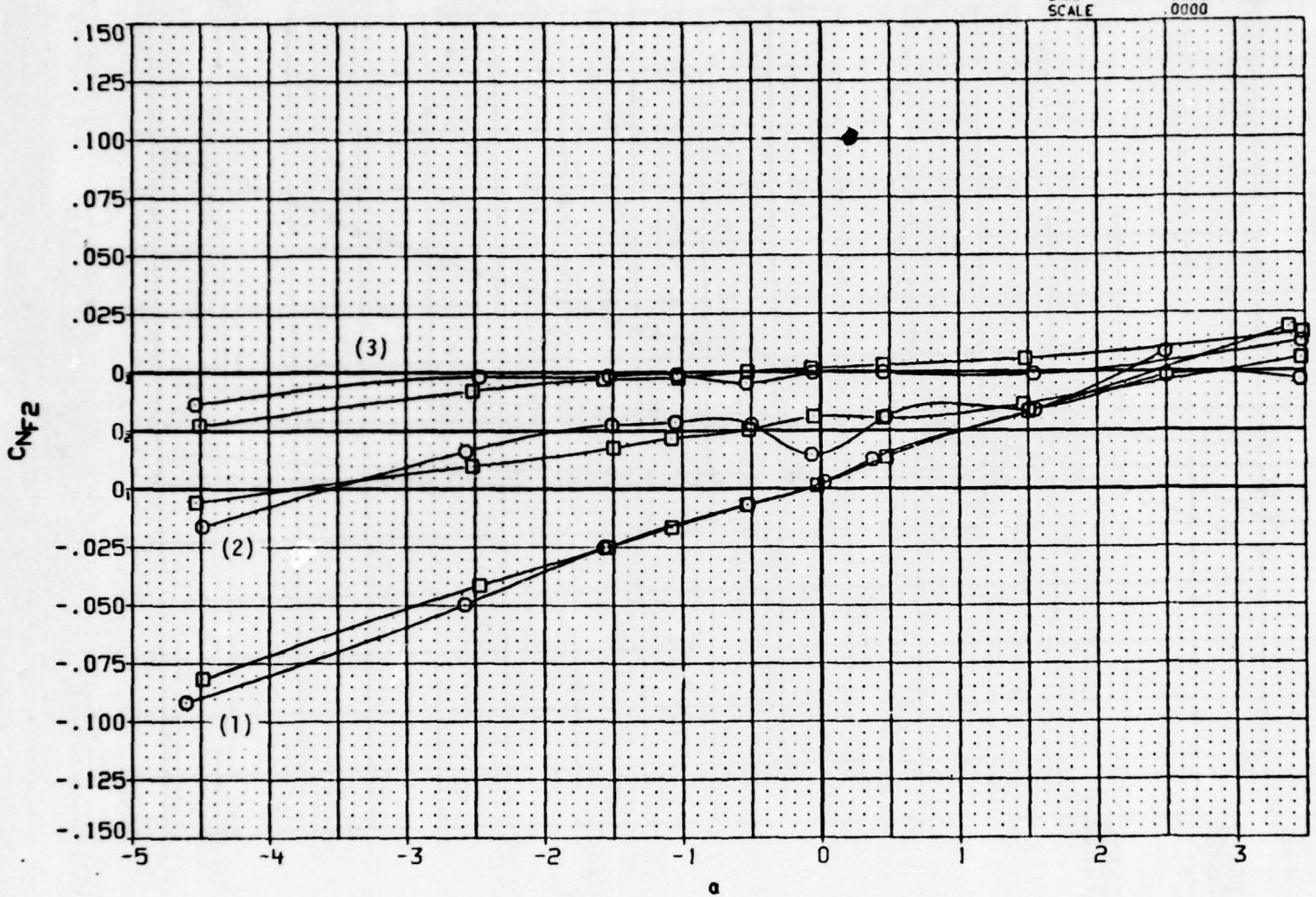
EFFECT OF GAP ON NORMAL FORCE AT VARIOUS THRUST LEVELS

(1) CRT = .01 (2) 4.18 (3) 5.97

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(EX8067)	○	CAL T17-123 (BF2) BODY, FIN IN AFT POSITION	.000	.700	.000
(DX8063)	□	CAL T17-123 (BF4) BODY, FIN IN AFT POSITION	.250	.700	.000

REFERENCE INFORMATION

SREF	19.6350	SQ. IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	

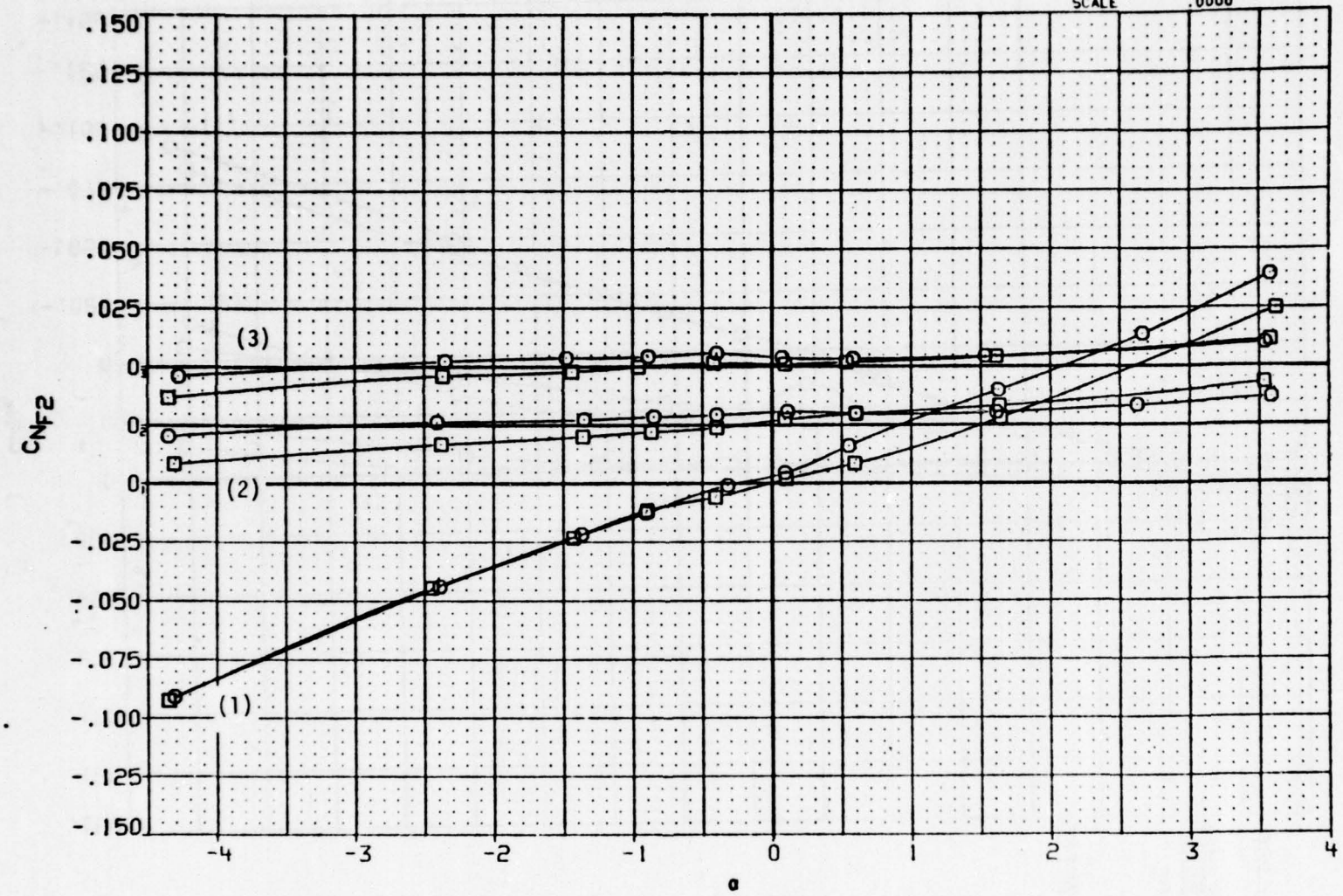


EFFECT OF GAP ON FIN NORMAL FORCE AT VARIOUS THRUST LEVELS

(1) CRT = .03 (2) 5.79 (3) 10.53

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(EX8068)	○	CAL T17-123 (BF2) BODY, FIN IN AFT POSITION	.000	.900	.000
(DX8064)	□	CAL T17-123 (BF4) BODY, FIN IN AFT POSITION	.250	.900	.000

REFERENCE INFORMATION		
SREF	19.6350	SQ.IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	

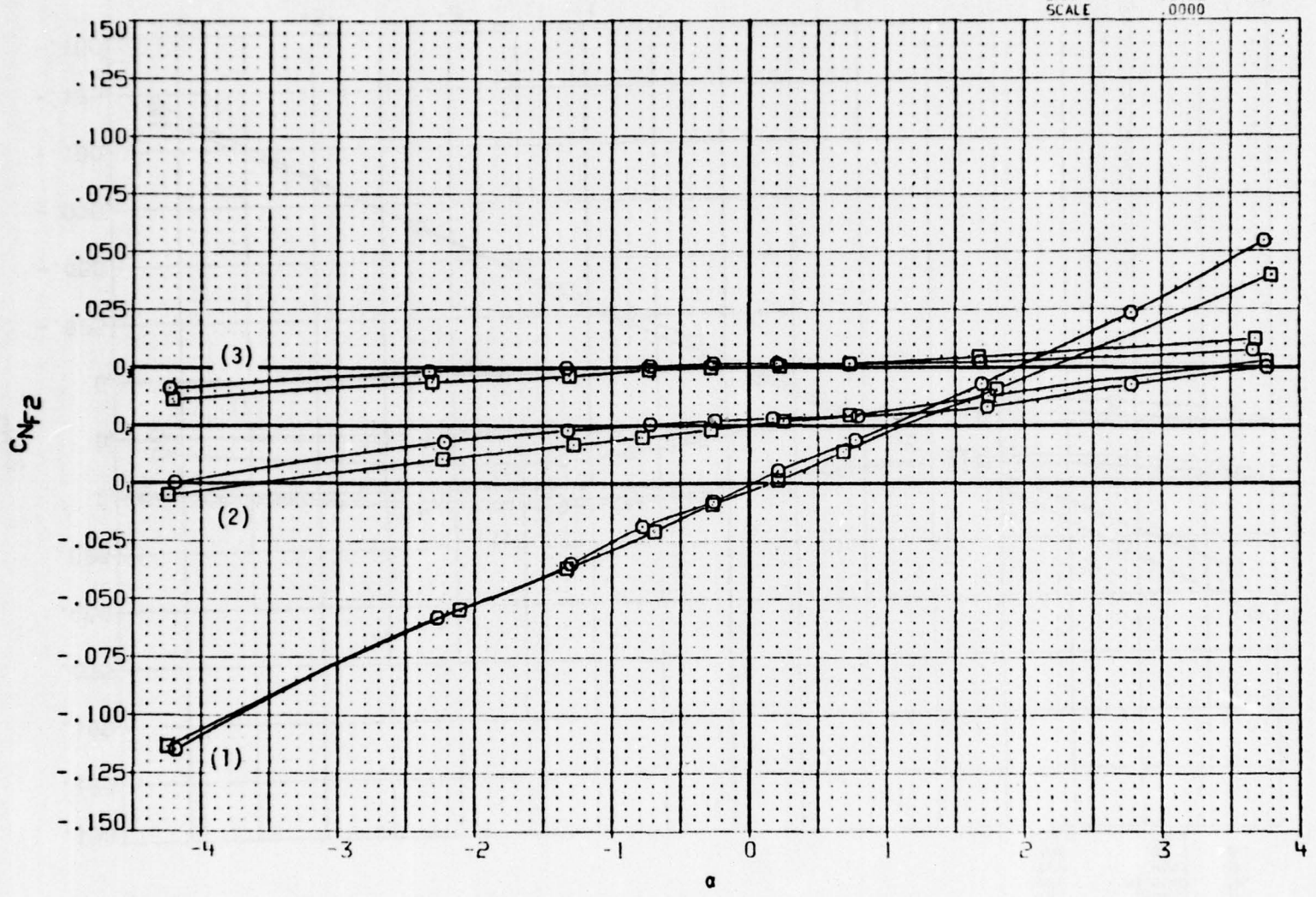


EFFECT OF GAP ON FIN NORMAL FORCE AT VARIOUS THRUST LEVELS

(1) CRT = .03 (2) 5.72 (3) 8.76

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(EX8069)	○	CAL 117-123 (BF2) BODY, FIN IN AFT POSITION	.000	1.000	.000
(DX8065)	□	CAL 117-123 (BF4) BODY, FIN IN AFT POSITION	.250	1.000	.000

REFERENCE INFORMATION		
SREF	19.6350	SQ. IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	

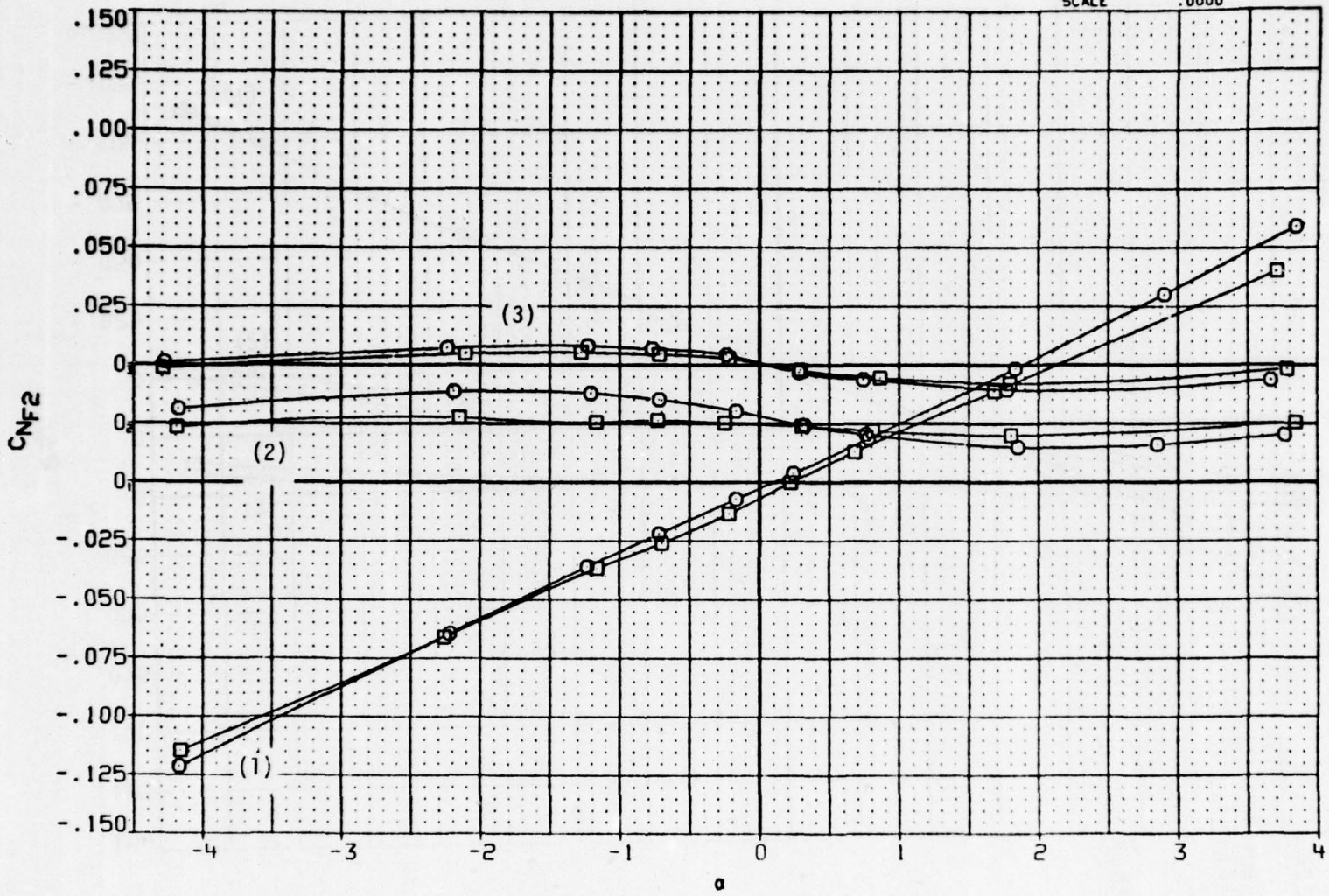


EFFECT OF GAP ON FIN NORMAL FORCE AT VARIOUS THRUST LEVELS

(1) CRT = .02 (2) 4.04 (3) 6.06

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(EXB070)	○	CAL T17-123 (BF2) BODY, FIN IN AFT POSITION	.000	1.200	.000
(DXB068)	□	CAL T17-123 (BF4) BODY, FIN IN AFT POSITION	.250	1.200	.000

REFERENCE INFORMATION		
SREF	19.6350	SQ. IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	

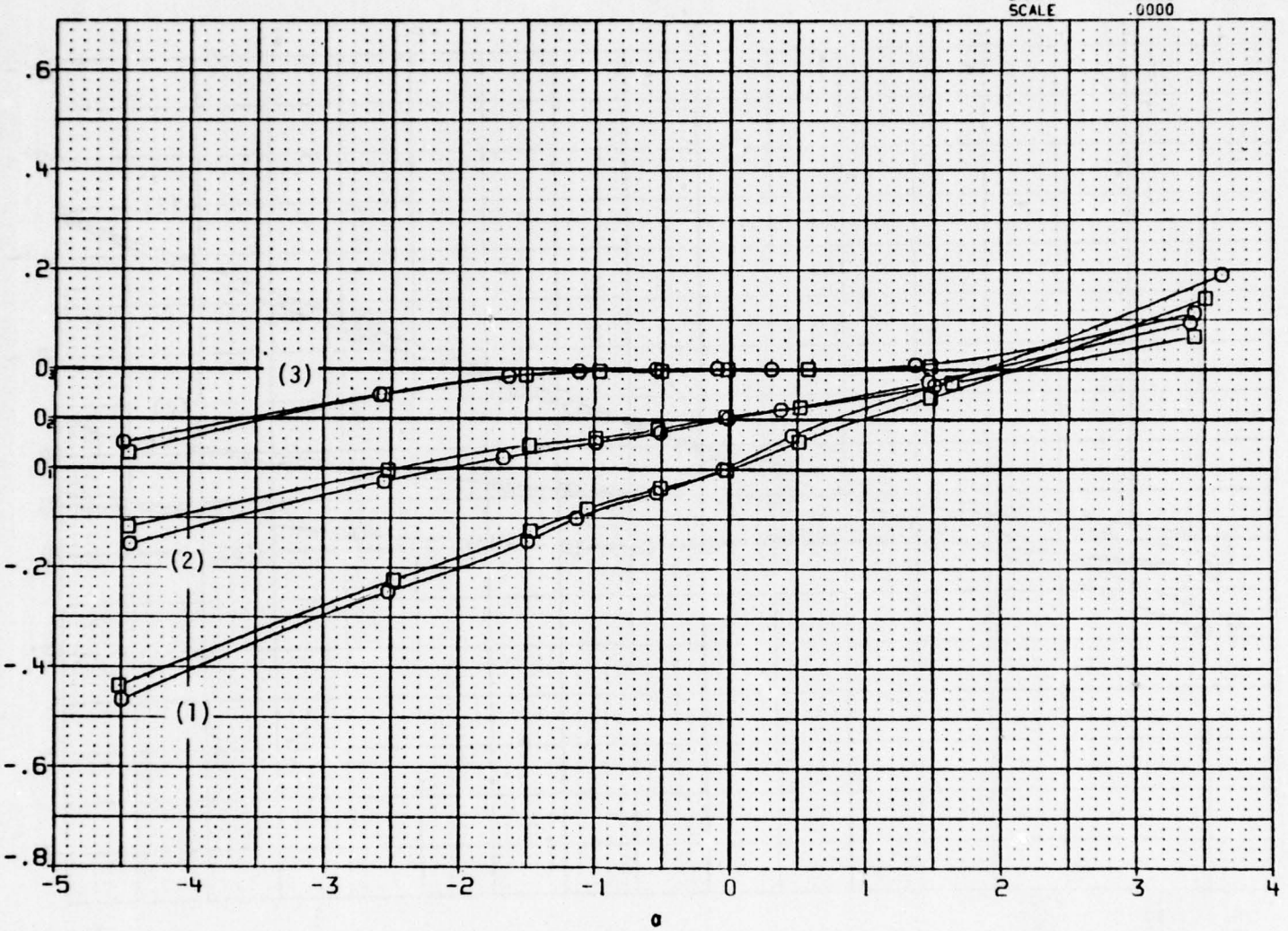


EFFECT OF GAP ON FIN NORMAL FORCE AT VARIOUS THRUST LEVELS

(1) CRT = .01 (2) 4.18 (3) 5.97

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(DX8045)	○	CAL T17-123 (BF2) BODY, FIN IN MID POSITION	.000	.700	.000
(DX8049)	□	CAL T17-123 (BF4) BODY, FIN IN MID POSITION	.250	.700	.000

REFERENCE INFORMATION		
SREF	19.6350	SQ. IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	



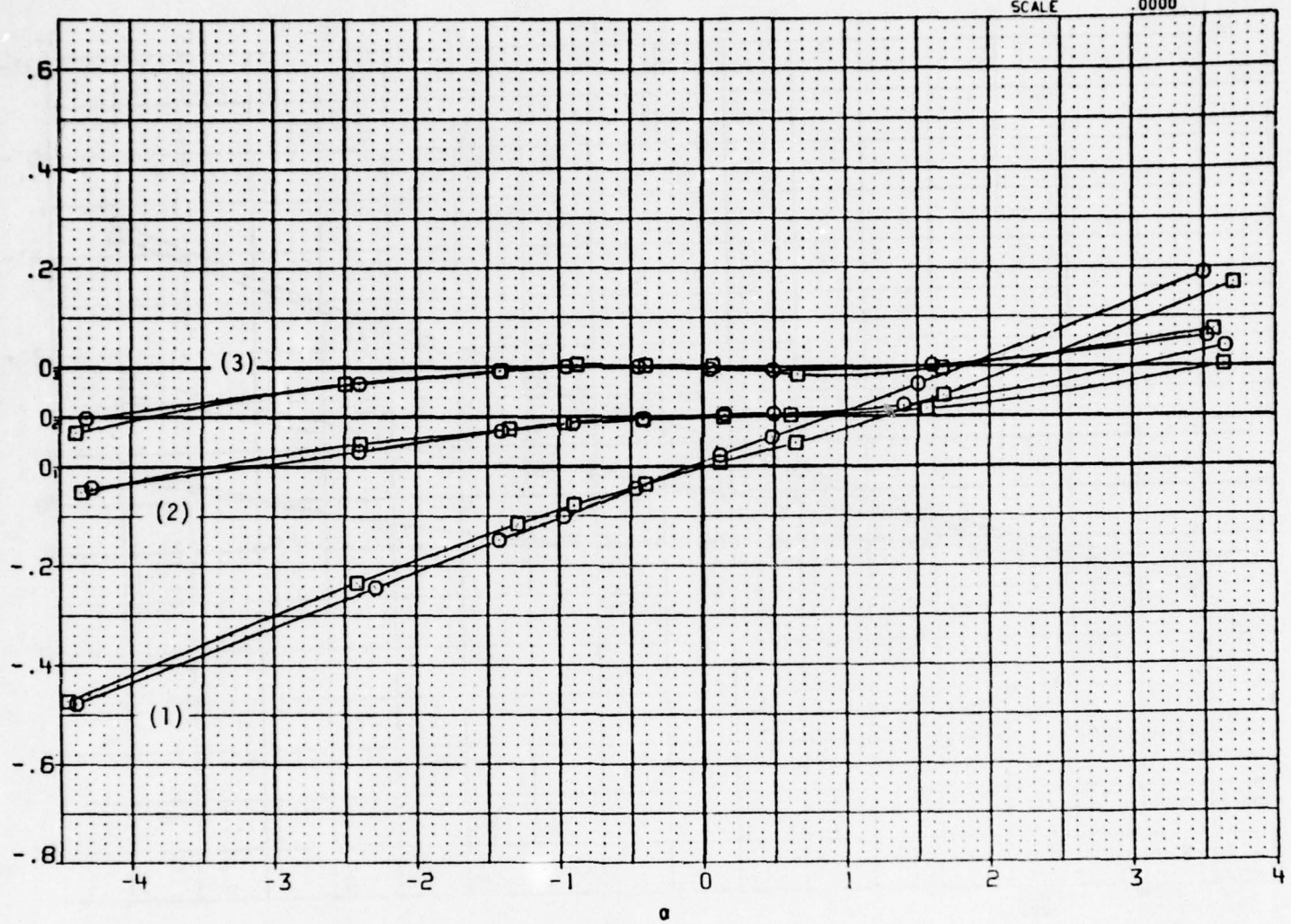
EFFECT OF GAP ON NORMAL FORCE AT VARIOUS THRUST LEVELS

(1) CRT = .08 (2) 5.87 (3) 10.76

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(DXB046)	○	CAL T17-123 (BF2) BODY, FIN IN MID POSITION	.000	.900	.000
(DXB050)	□	CAL T17-123 (BF4) BODY, FIN IN MID POSITION	.250	.900	.000

REFERENCE INFORMATION

SREF	19.6350	SQ. IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	



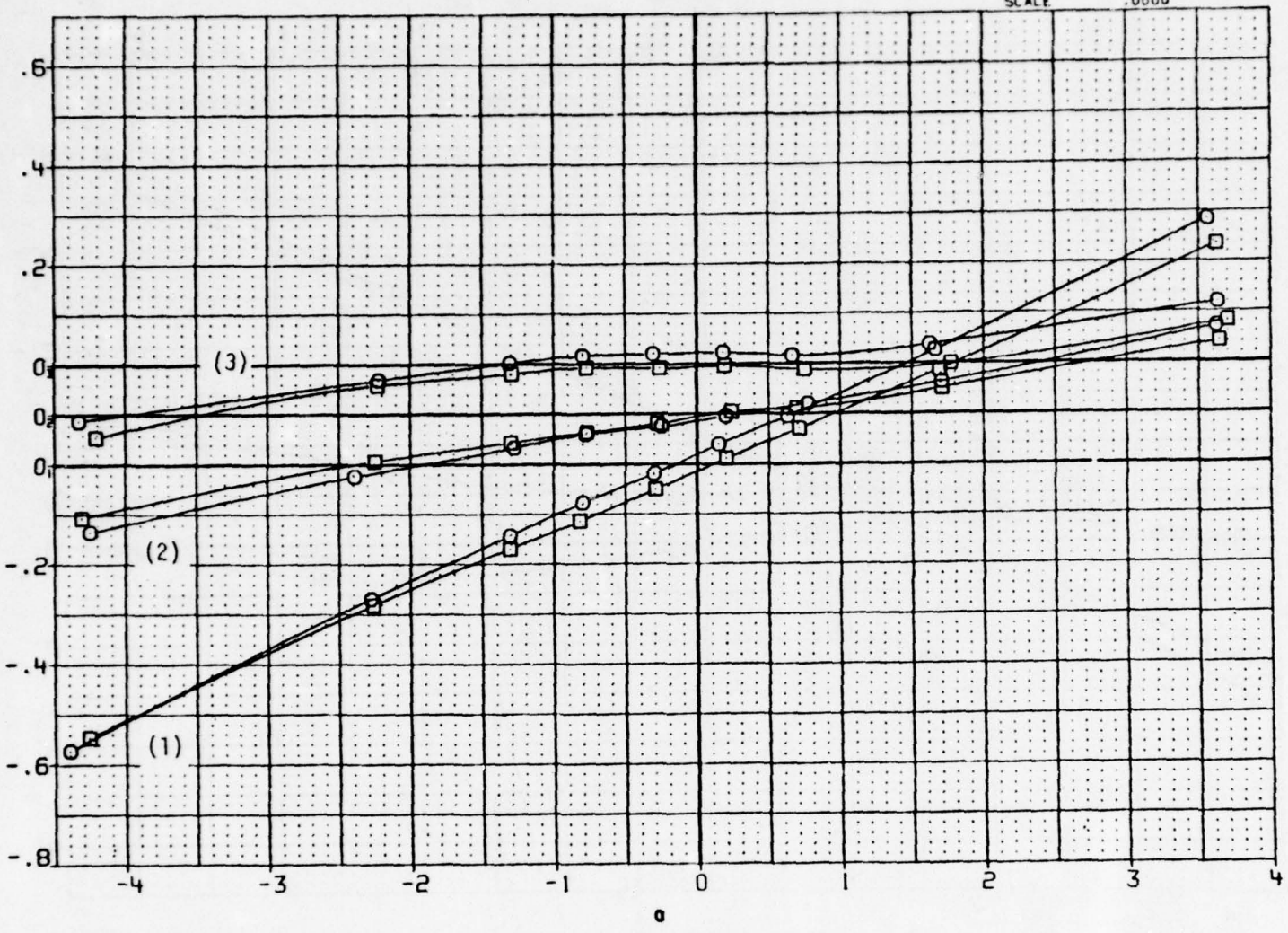
EFFECT OF GAP ON NORMAL FORCE AT VARIOUS THRUST LEVELS

(1) CRT = .05 (2) 5.65 (3) 8.60

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(DX8047)	○	CAL T17-123 (BF2) BODY, FIN IN MID POSITION	.000	1.000	.000
(DX8051)	□	CAL T17-123 (BF4) BODY, FIN IN MID POSITION	.250	1.000	.000

REFERENCE INFORMATION

SREF	19.6350	SQ. IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	



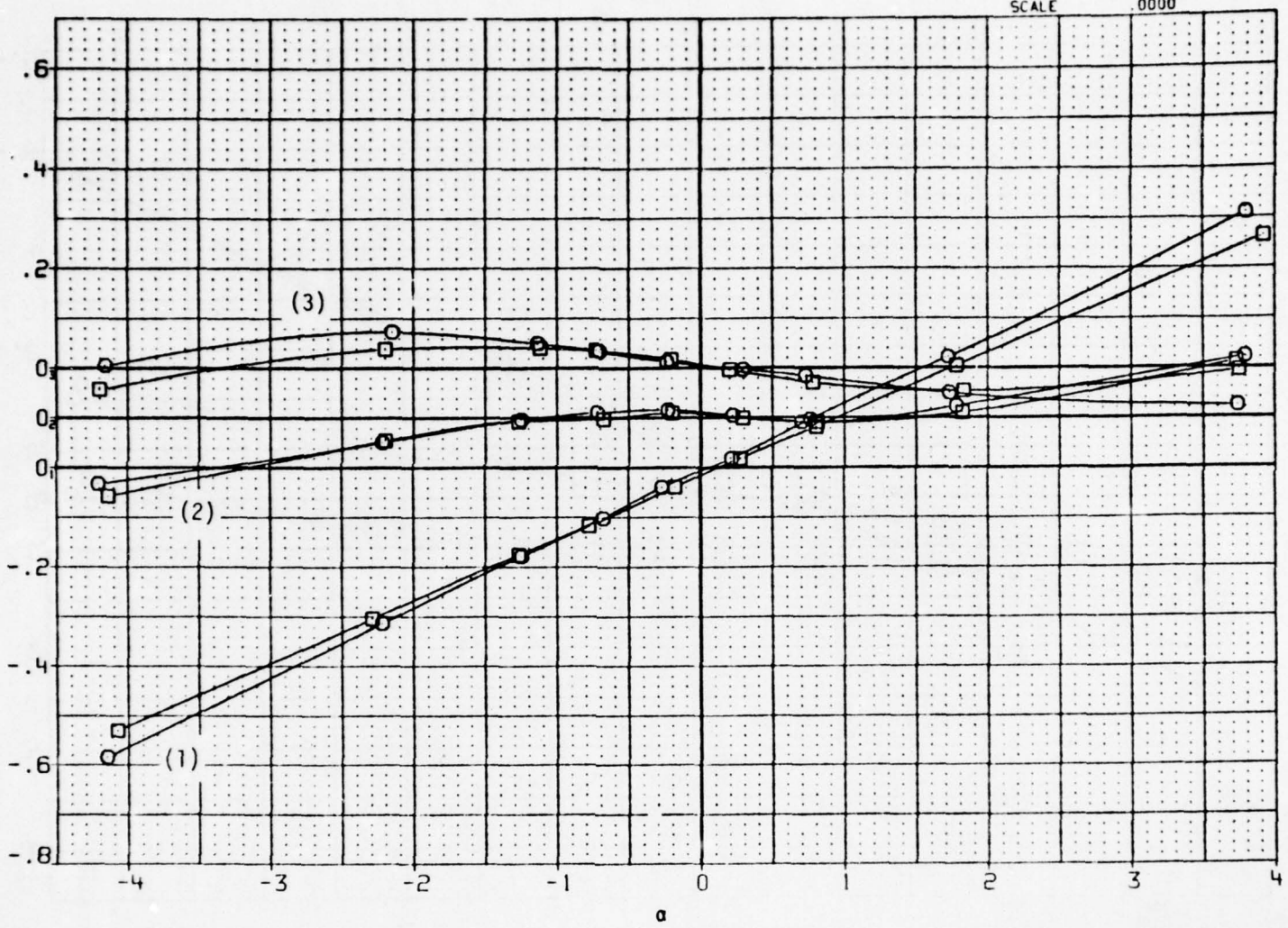
EFFECT OF GAP ON NORMAL FORCE AT VARIOUS THRUST LEVELS

(1) CRT = .05 (2) 4.13 (3) 5.71

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(DX8048)	○	CAL T17-123 (BF2) BODY, FIN IN MID POSITION	.000	1.200	.000
(DX8052)	□	CAL T17-123 (BF4) BODY, FIN IN MID POSITION	.250	1.200	.000

REFERENCE INFORMATION

SREF	19.6350	SQ. IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	



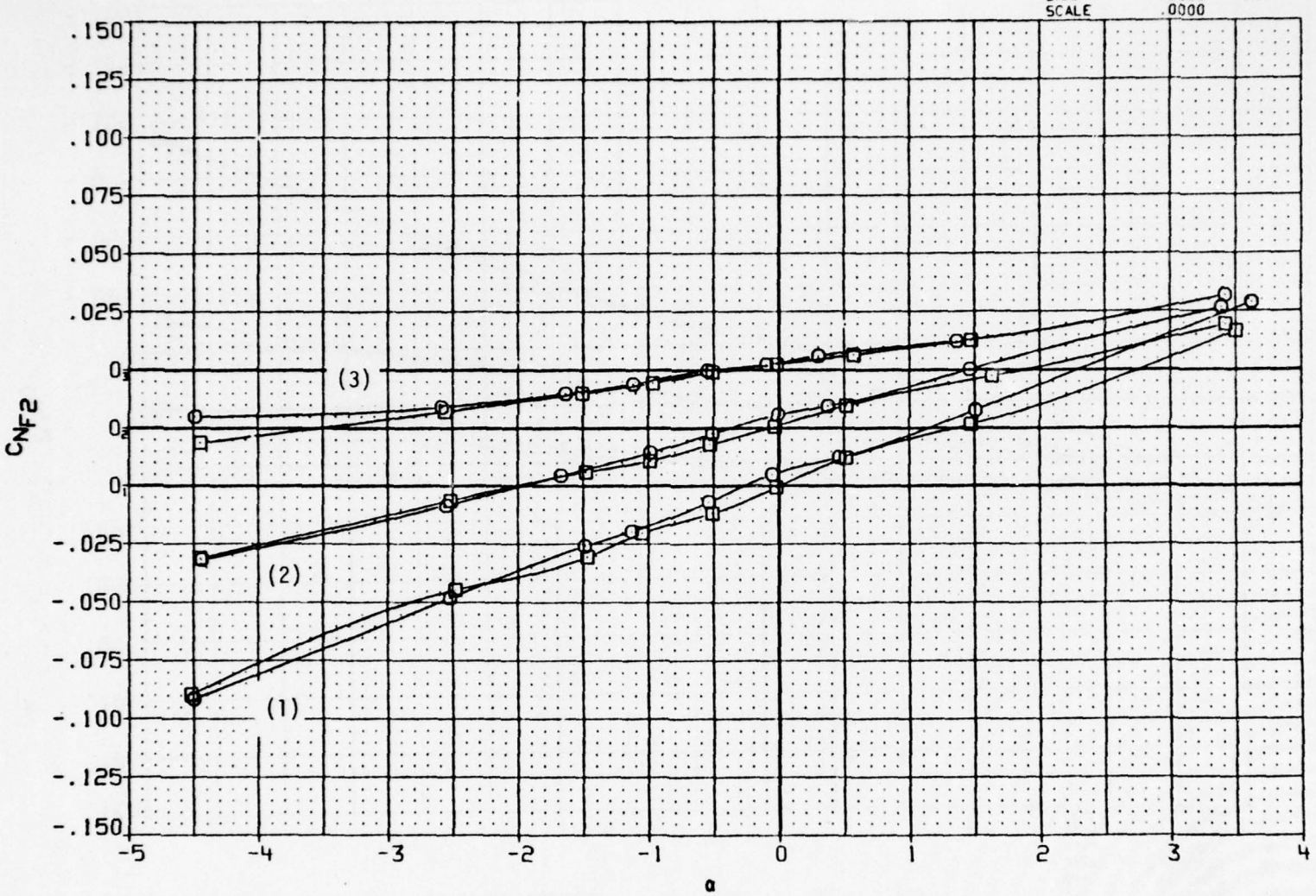
EFFECT OF GAP ON NORMAL FORCE AT VARIOUS THRUST LEVELS

(1) CRT = .03 (2) 4.24 (3) 5.75

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(DX8045)	○	CAL T17-123 (BF2) BODY, FIN IN MID POSITION	.000	.700	.000
(DX8049)	□	CAL T17-123 (BF4) BODY, FIN IN MID POSITION	.250	.700	.000

REFERENCE INFORMATION

SREF	19.6350	SQ. IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	



EFFECT OF GAP ON FIN NORMAL FORCE AT VARIOUS THRUST LEVELS

(1) CRT = .08 (2) 5.87 (3) 10.76

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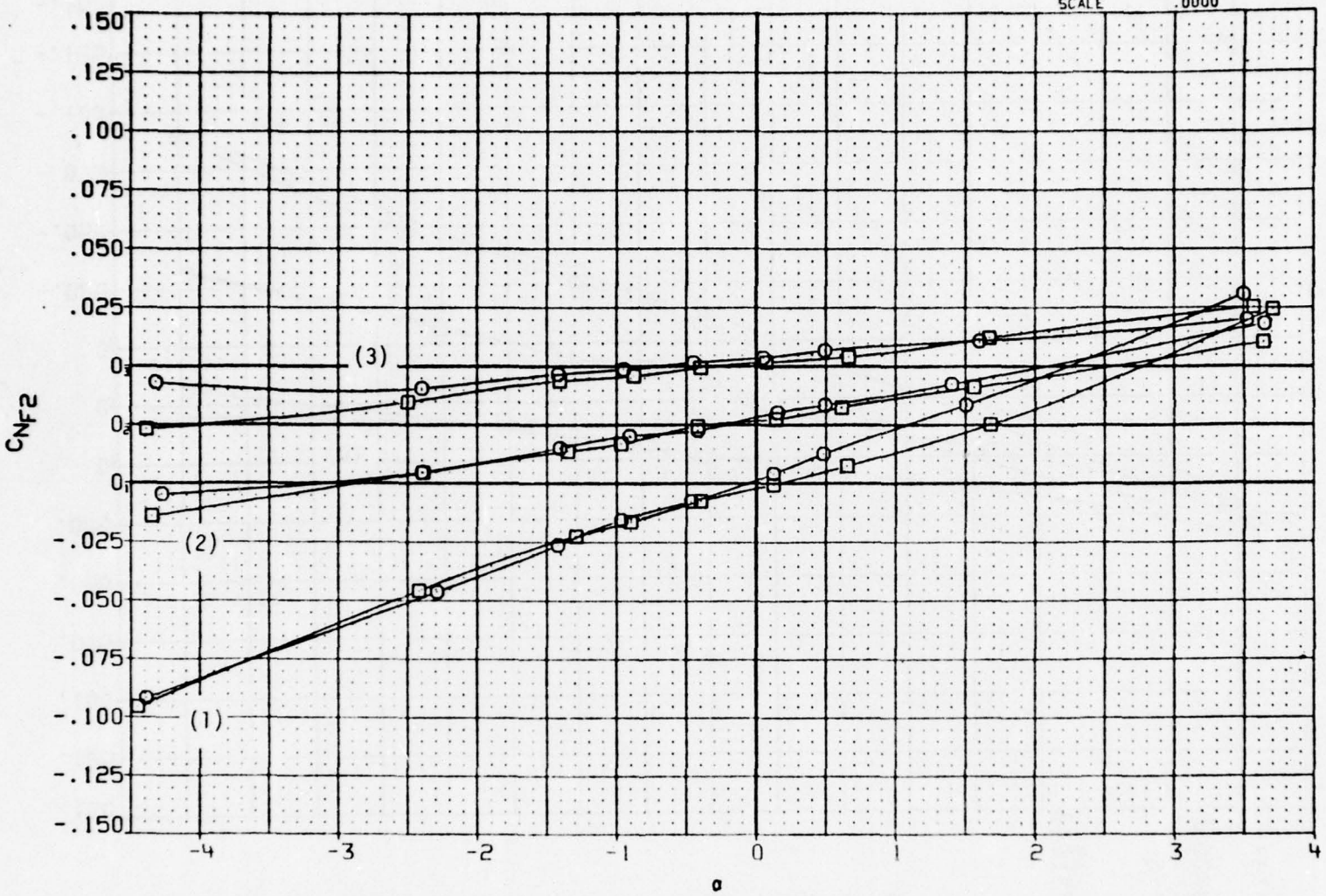
DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(DX8048)	○	CAL T17-123 (BF2) BODY, FIN IN MID POSITION	.000	.900	.000
(DX8050)	□	CAL T17-123 (BF4) BODY, FIN IN MID POSITION	.250	.900	.000

REFERENCE INFORMATION

SREF	19.6350	SQ. IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	

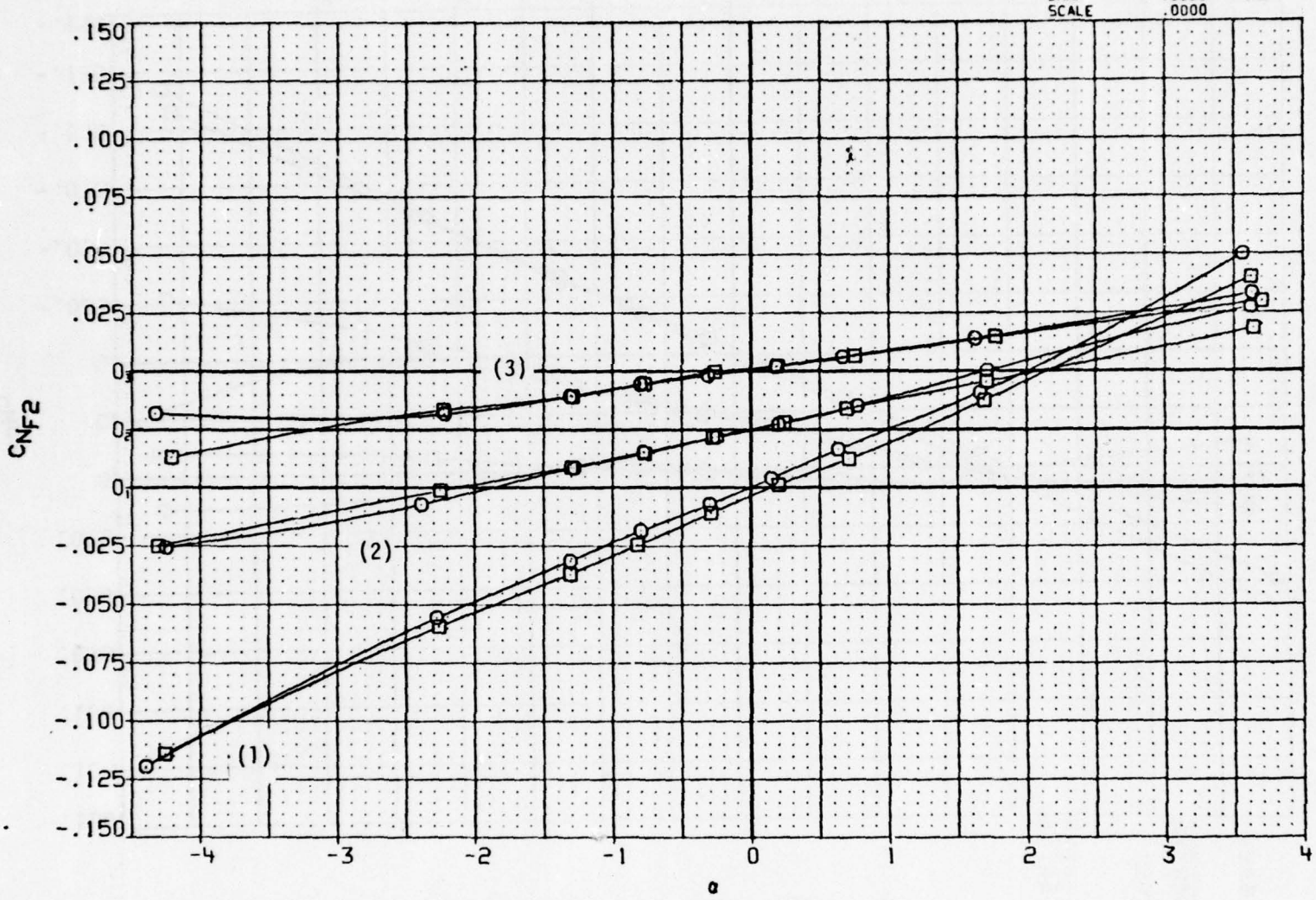


EFFECT OF GAP ON FIN NORMAL FORCE AT VARIOUS THRUST LEVELS

(1) CRT = .05 (2) 5.65 (3) 8.60

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(DX8047)	○	CAL T17-123 (BF2) BODY, FIN IN MID POSITION	.000	1.000	.000
(DX8051)	□	CAL T17-123 (BF4) BODY, FIN IN MID POSITION	.250	1.000	.000

REFERENCE INFORMATION		
SREF	19.6350	SQ.IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	



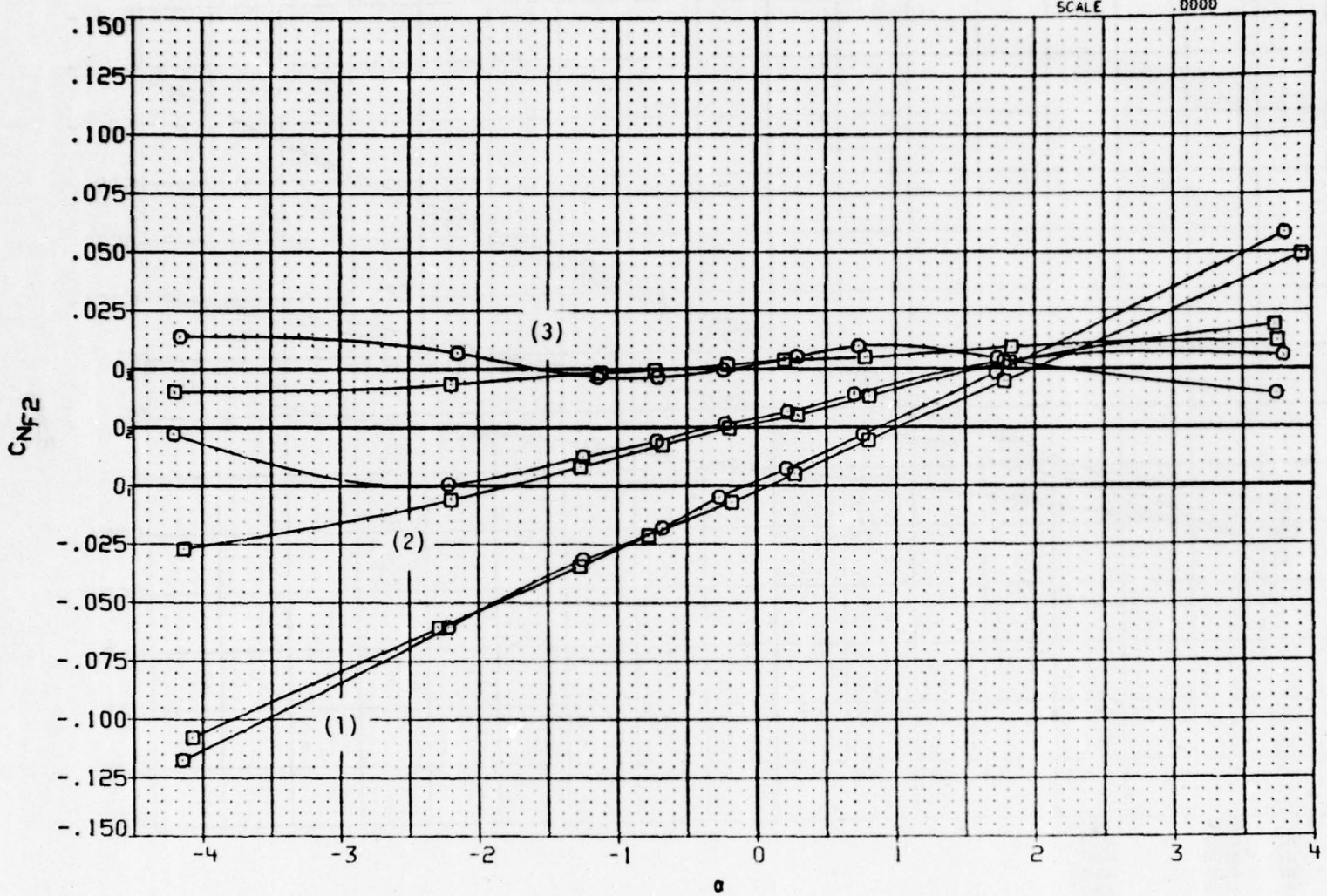
EFFECT OF GAP ON FIN NORMAL FORCE AT VARIOUS THRUST LEVELS

(1) CRT = .05 (2) 4.13 (3) 5.71

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(DX8048)	○	CAL T17-123 (BF2) BODY, FIN IN MID POSITION	.000	1.200	.000
(DX8052)	□	CAL T17-123 (BF4) BODY, FIN IN MID POSITION	.250	1.200	.000

REFERENCE INFORMATION

SREF	19.6350	SQ. IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	



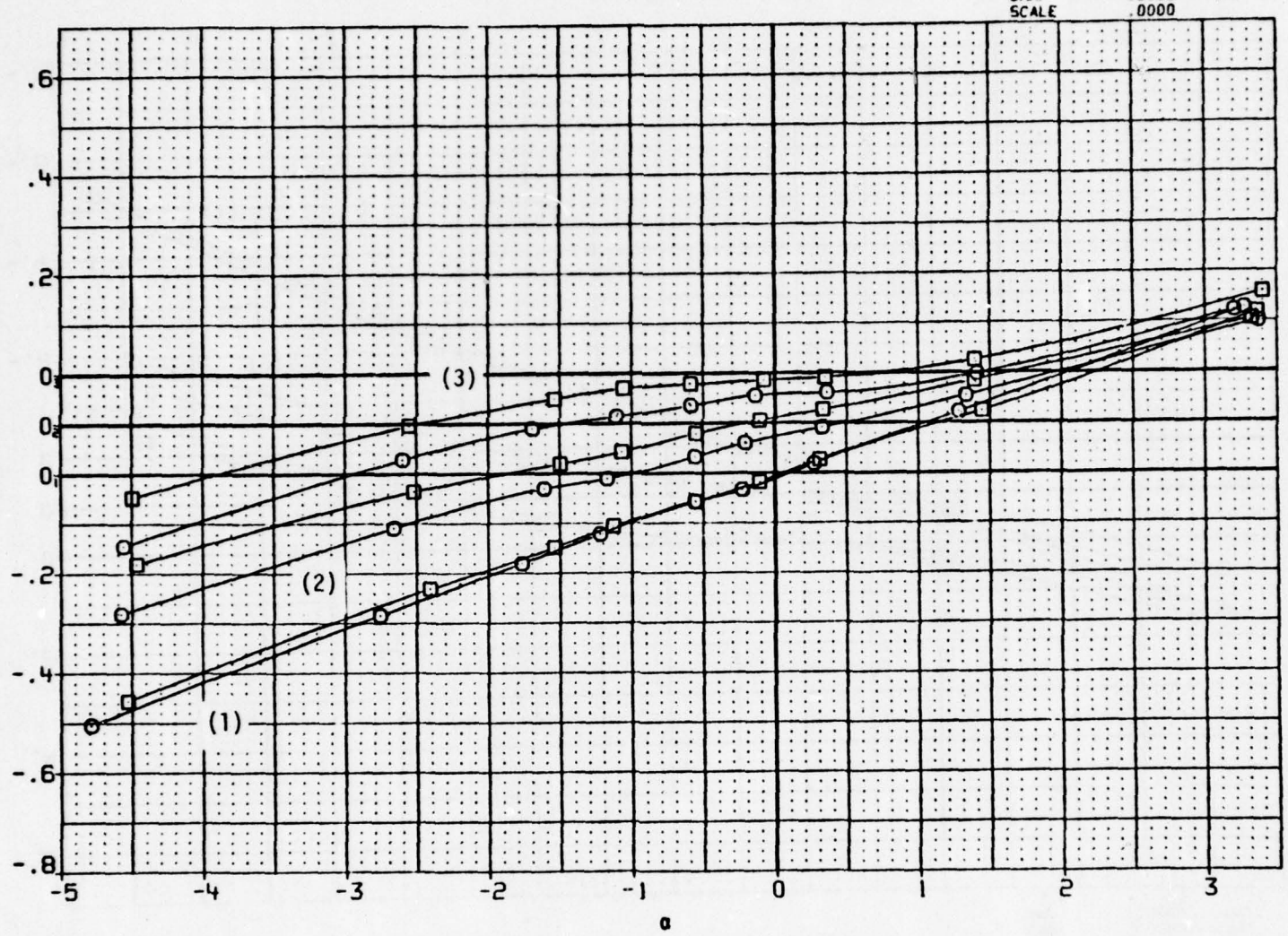
EFFECT OF GAP ON FIN NORMAL FORCE AT VARIOUS THRUST LEVELS

(1) CRT = .03 (2) 4.24 (3) 5.75

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(EX8013)	○	CAL T17-123 (BF2) BODY, FIN IN FORWARD POSITION	.000	.700	.000
(DX8025)	□	CAL T17-123 (BF4) BODY, FIN IN FORWARD POSITION	.250	.700	.000

REFERENCE INFORMATION

SREF	19.6350	SQ.IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	



EFFECT OF GAP ON NORMAL FORCE AT VARIOUS THRUST LEVELS

(1) CRT = .07 (2) 5.91 (3) 10.05

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(EXB014)	○	CAL T17-123 (BF2) BODY, FIN IN FORWARD POSITION	.000	.900	.000
(DX8026)	□	CAL T17-123 (BF4) BODY, FIN IN FORWARD POSITION	.250	.900	.000

REFERENCE INFORMATION

SREF	19.6350	SQ. IN.
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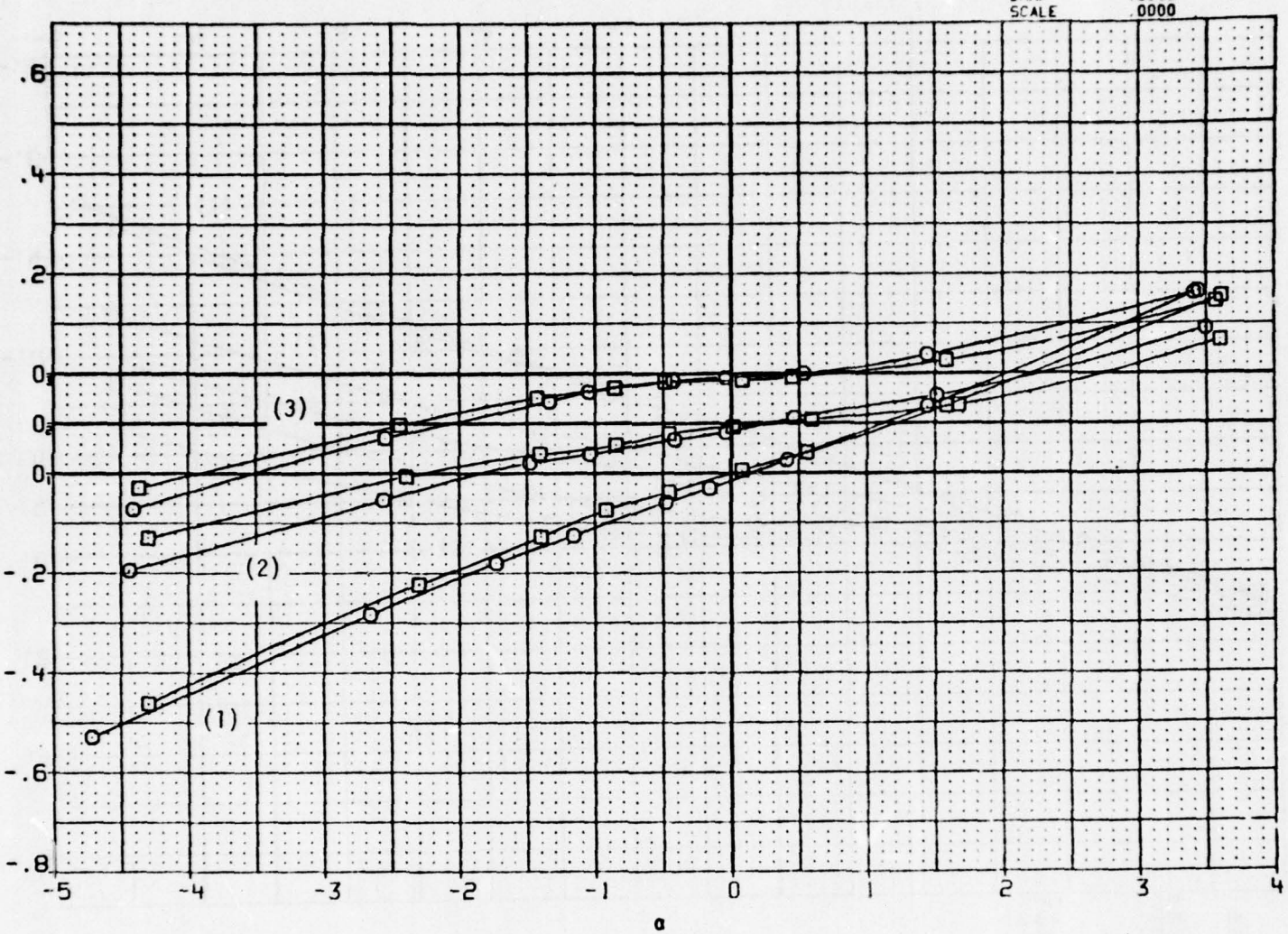
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	



EFFECT OF GAP ON NORMAL FORCE AT VARIOUS THRUST LEVELS

(1) CRT = .03 (2) 5.83 (3) 8.87

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(EX8015)	○	CAL T17-123 (BF2) BODY, FIN IN FORWARD POSITION	.000	1.000	.000
(DX8027)	□	CAL T17-123 (BF4) BODY, FIN IN FORWARD POSITION	.250	1.000	.000

REFERENCE INFORMATION		
SREF	19.6350	SQ. IN.
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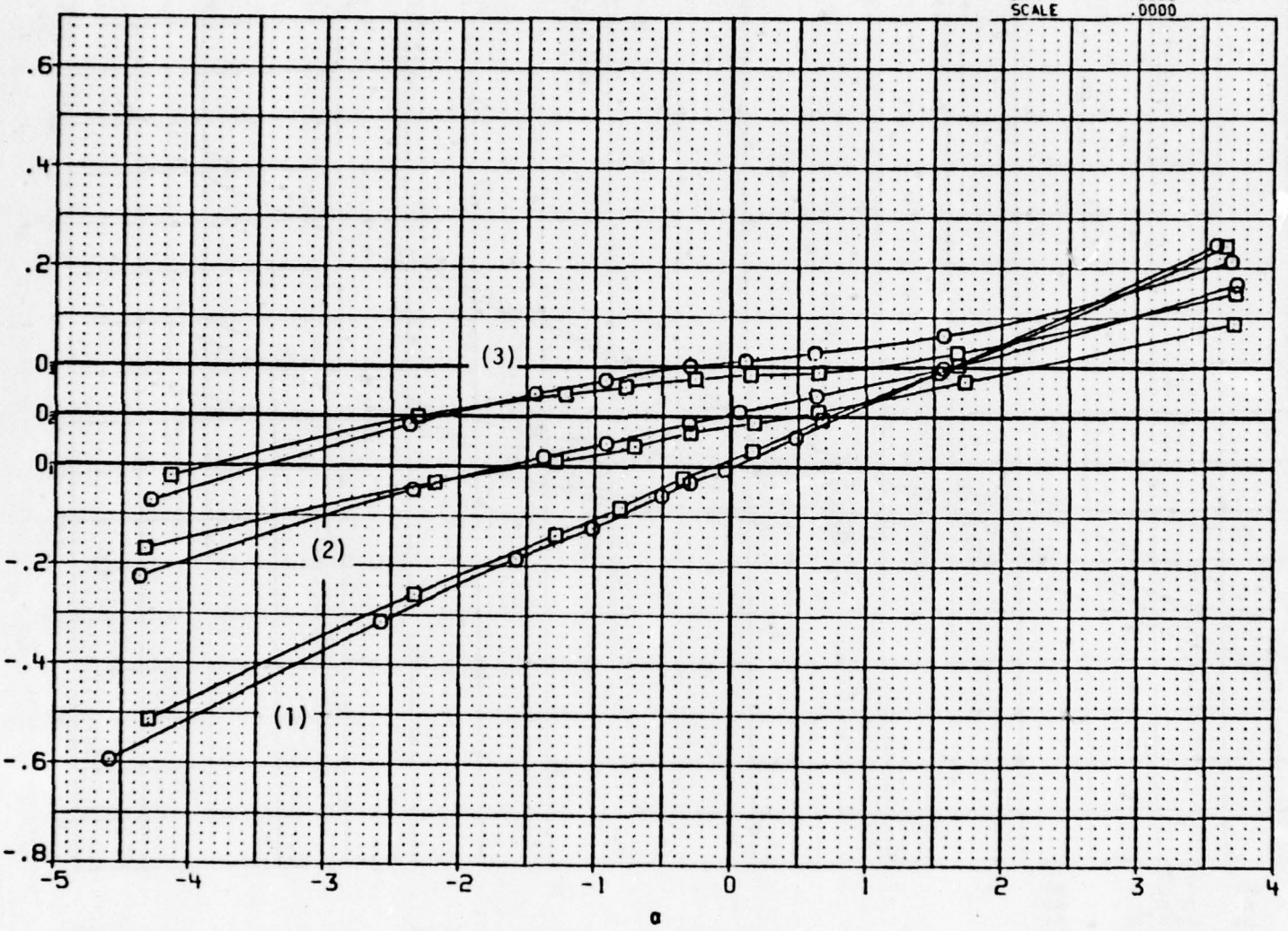
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	



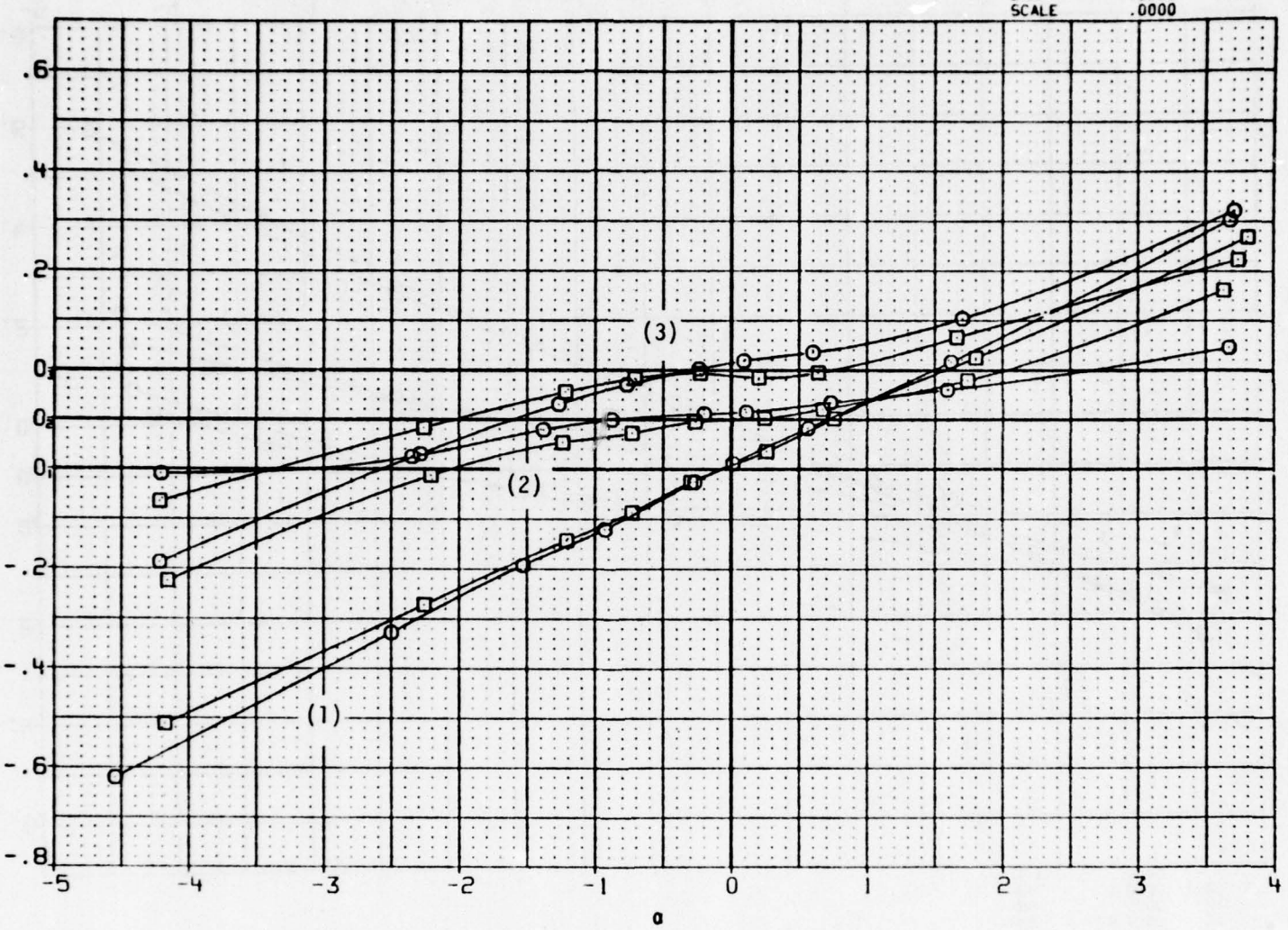
EFFECT OF GAP ON NORMAL FORCE AT VARIOUS THRUST LEVELS

(1) CRT = .03 (2) 4.18 (3) 5.99

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(EXB016)	○	CAL T17-123 (BF2) BODY, FIN IN FORWARD POSITION	.000	1.200	.000
(DXB020)	□	CAL T17-123 (BF4) BODY, FIN IN FORWARD POSITION	.250	1.200	.000

REFERENCE INFORMATION

SREF	19.6350	SQ. IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	



EFFECT OF GAP ON NORMAL FORCE AT VARIOUS THRUST LEVELS

(1) CRT = .02 (2) 4.20 (3) 5.90

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(EX8013)	○	CAL T17-123 (BF2) BODY, FIN IN FORWARD POSITION	.000	.700	.000
(DX8025)	□	CAL T17-123 (BF4) BODY, FIN IN FORWARD POSITION	.250	.700	.000

REFERENCE INFORMATION		
SREF	19.6350	SQ. IN.
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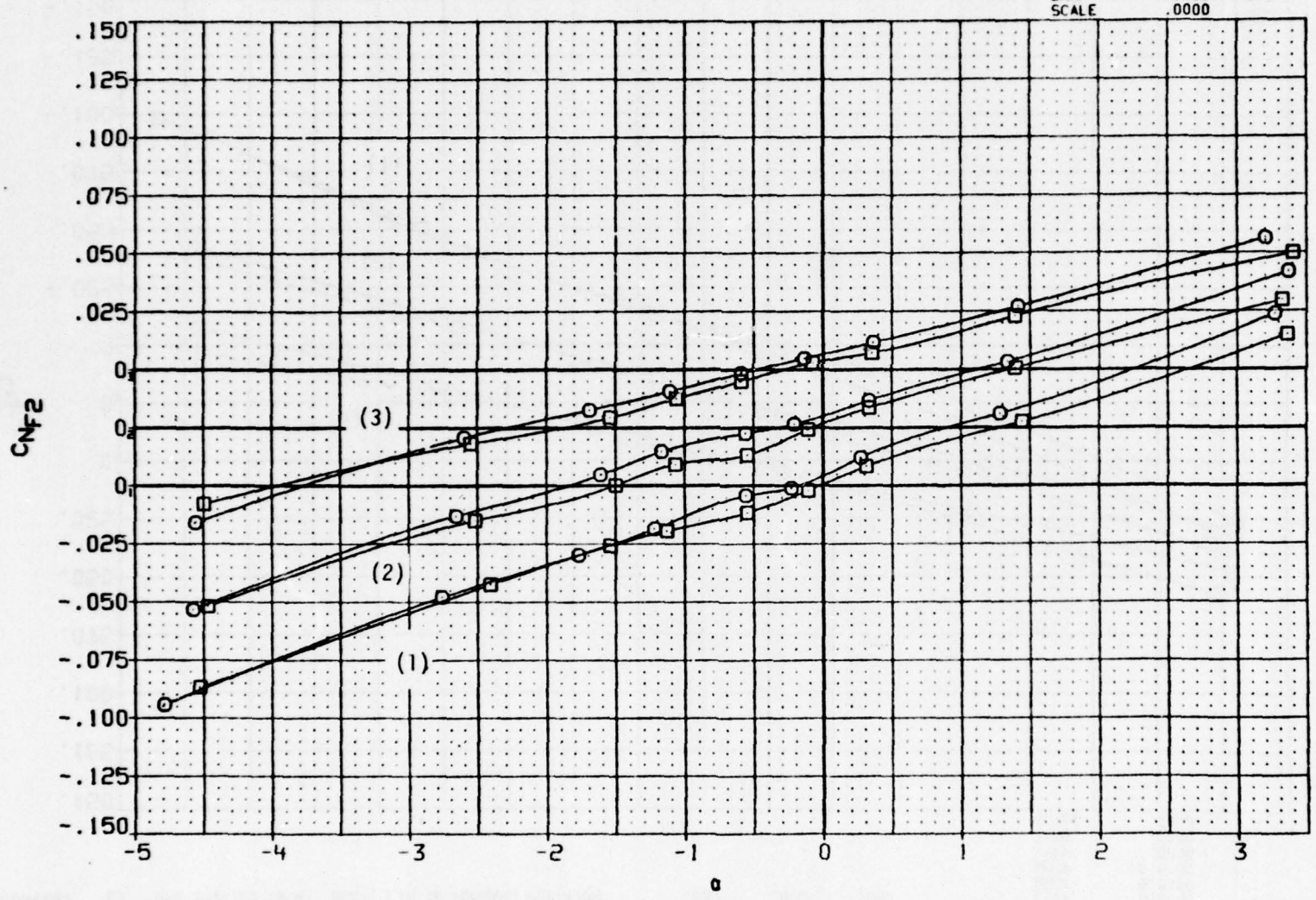
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	



EFFECT OF GAP ON FIN NORMAL FORCE AT VARIOUS THRUST LEVELS

(1) CRT = .07 (2) 5.91 (3) 10.05

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(EX8014)	○	CAL T17-123 (BF2) BODY, FIN IN FORWARD POSITION	.000	.900	.000
(DX8028)	□	CAL T17-123 (BF4) BODY, FIN IN FORWARD POSITION	.250	.900	.000

REFERENCE INFORMATION		
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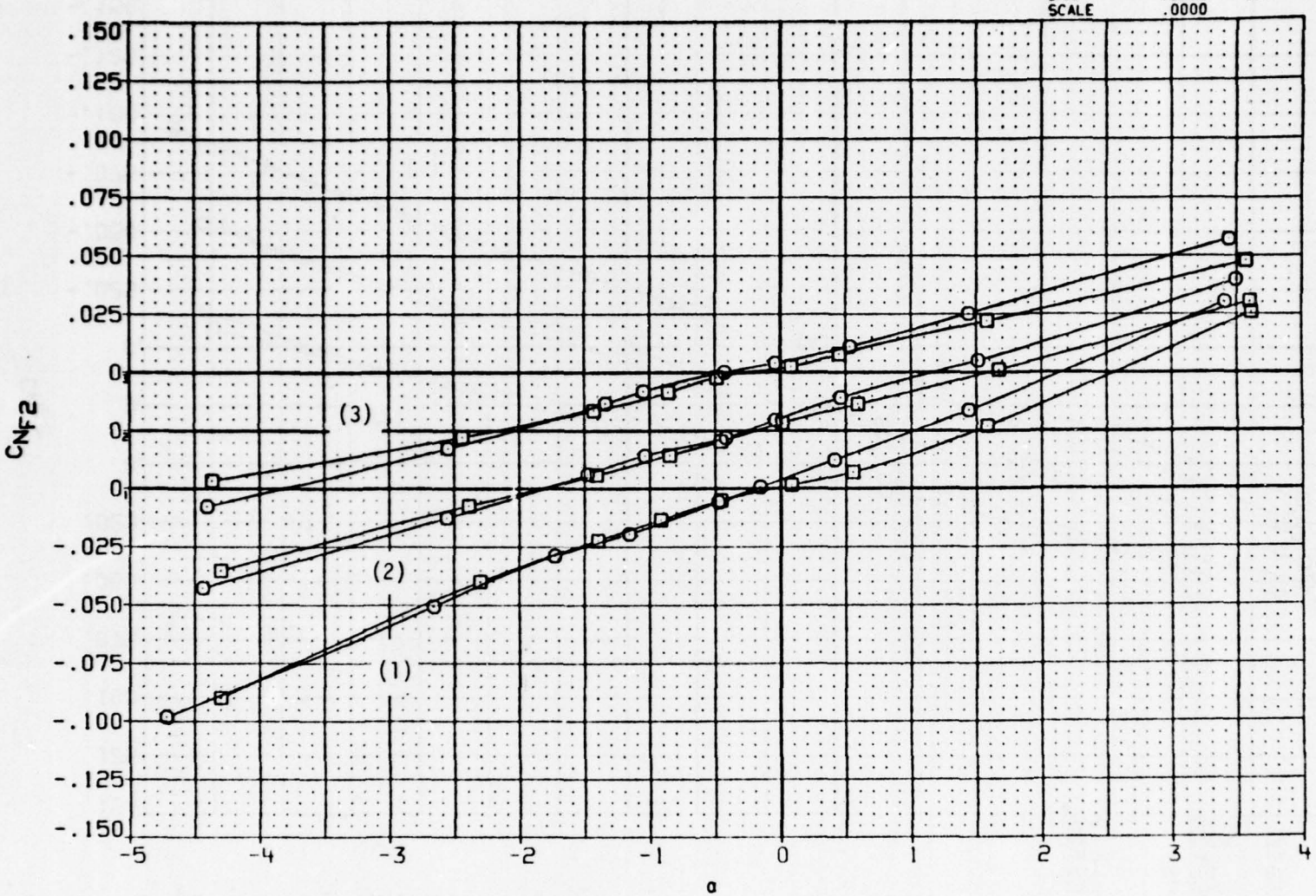
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	

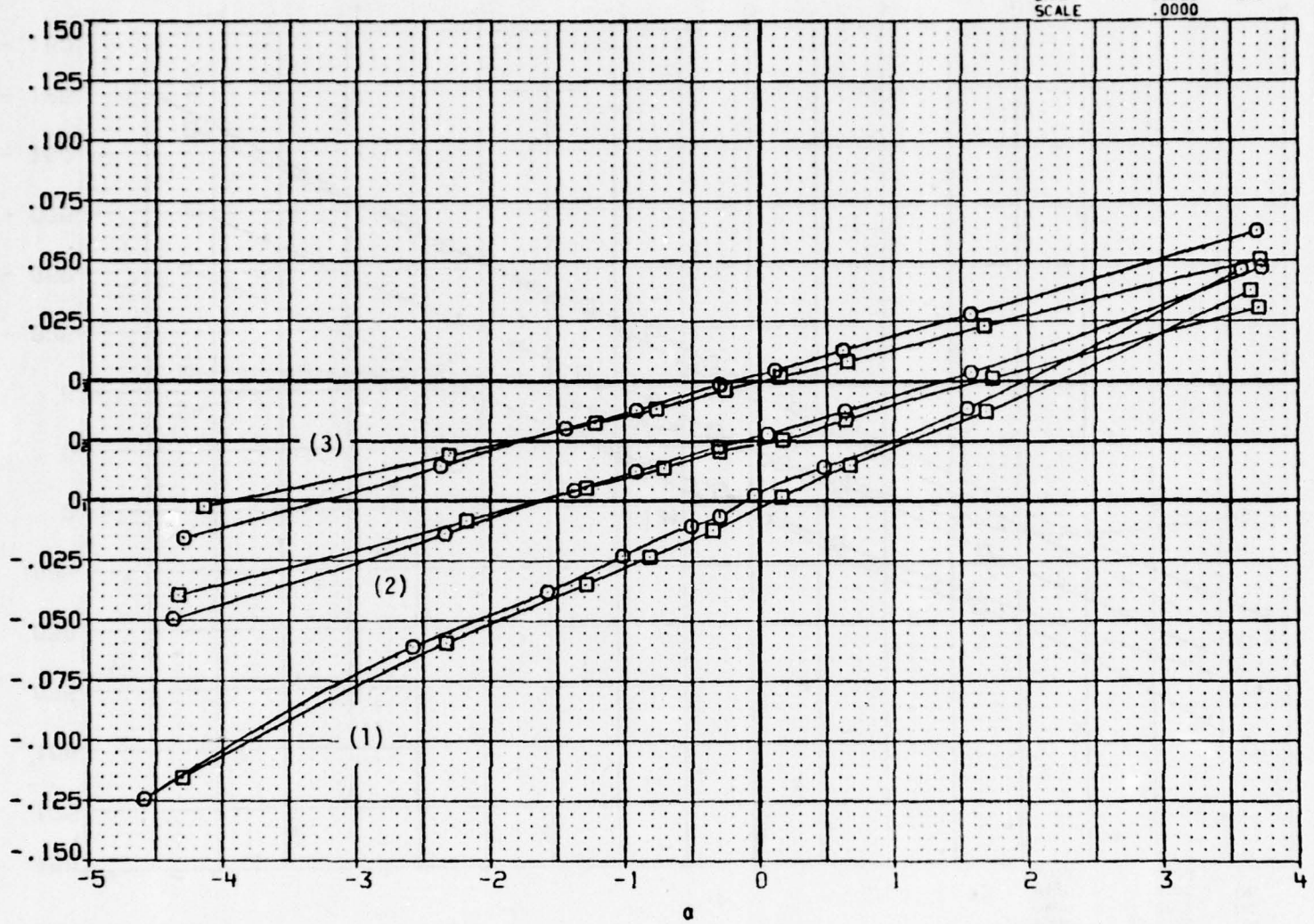


EFFECT OF GAP ON FIN NORMAL FORCE AT VARIOUS THRUST LEVELS

(1) CRT = .03 (2) 5.83 (3) 8.87

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(EX8015)	○	CAL T17-123 (BF2) BODY, FIN IN FORWARD POSITION	.000	1.000	.000
(DX8027)	□	CAL T17-123 (BF4) BODY, FIN IN FORWARD POSITION	.250	1.000	.000

REFERENCE INFORMATION		
SREF	19.6350	SQ. IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	



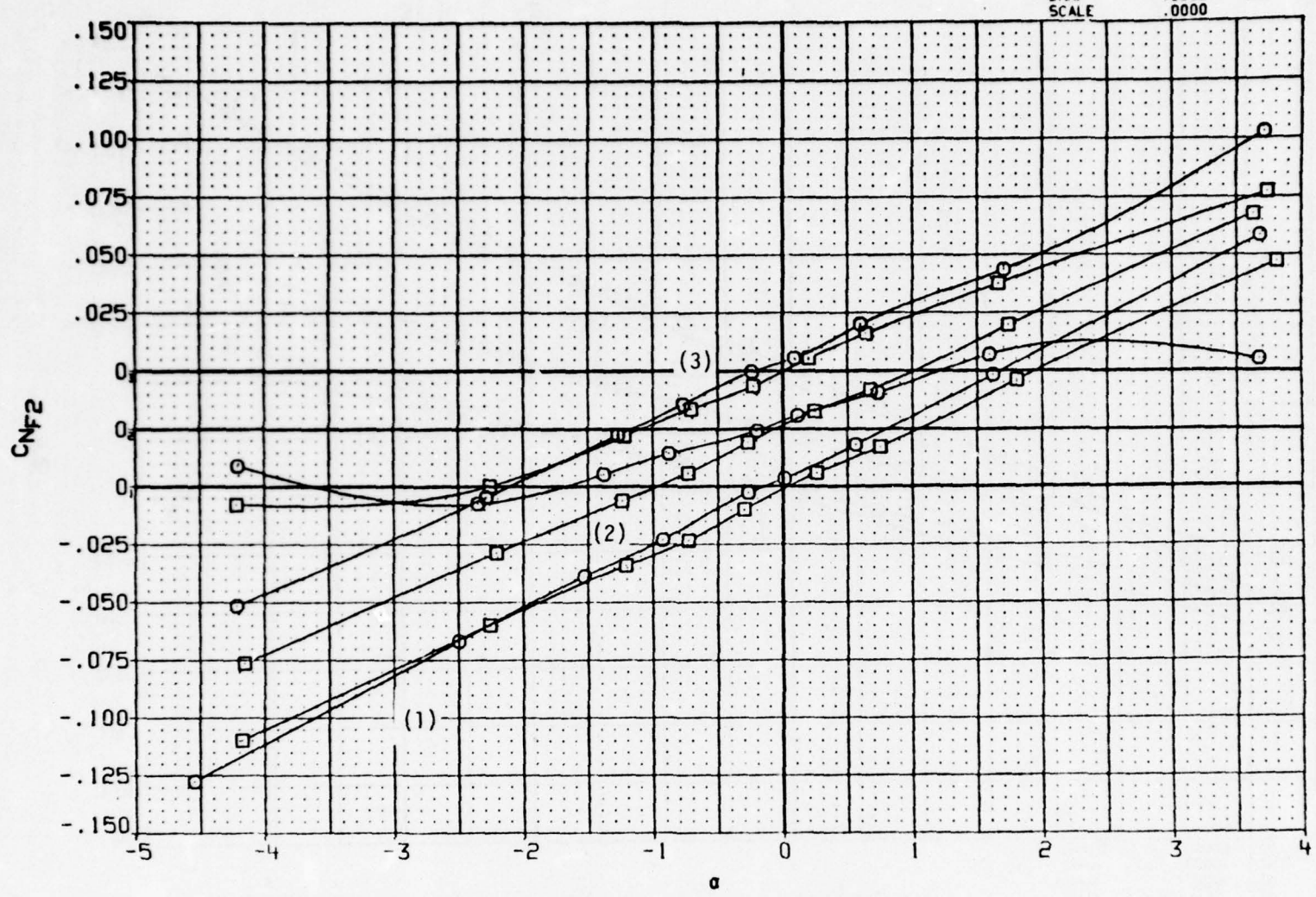
EFFECT OF GAP ON FIN NORMAL FORCE AT VARIOUS THRUST LEVELS

(1) CRT = .03 (2) 4.18 (3) 5.99

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(EX80161)	○	CAL T17-123 (BF2) BODY, FIN IN FORWARD POSITION	.000	1.200	.000
(DX80281)	□	CAL T17-123 (BF4) BODY, FIN IN FORWARD POSITION	.250	1.200	.000

REFERENCE INFORMATION

SREF	19.6350	SQ. IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	



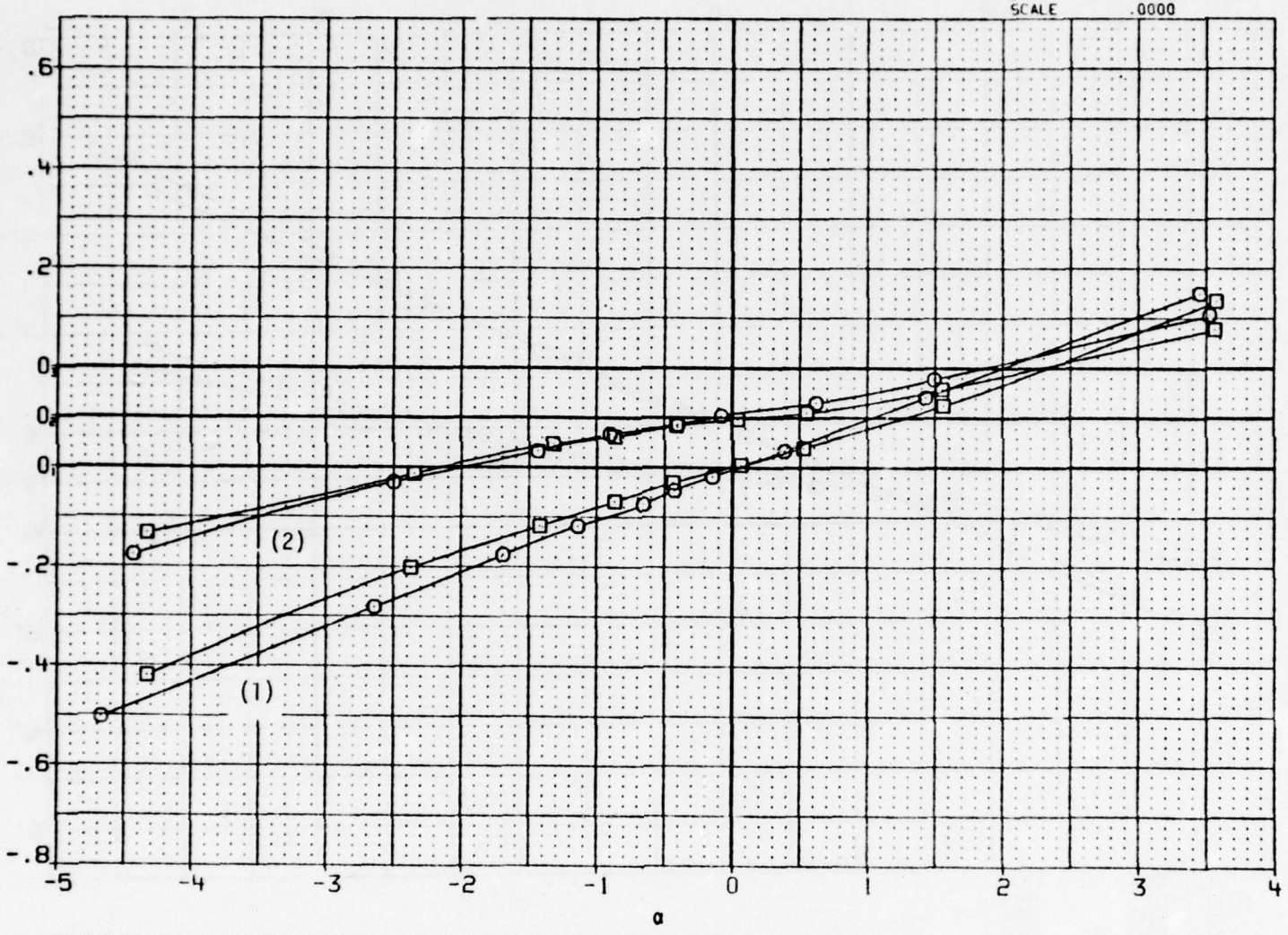
EFFECT OF GAP ON FIN NORMAL FORCE AT VARIOUS THRUST LEVELS

(1) CRT = .02 (2) 4.20 (3) 5.90

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(EX8017)	○	CAL T17-123 (BF2) BODY, FIN IN FORWARD POSITION	.000	.900	45.000
(DX8029)	□	CAL T17-123 (BF4) BODY, FIN IN FORWARD POSITION	.250	.900	45.000

REFERENCE INFORMATION

SREF	19.6350	SQ. IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	

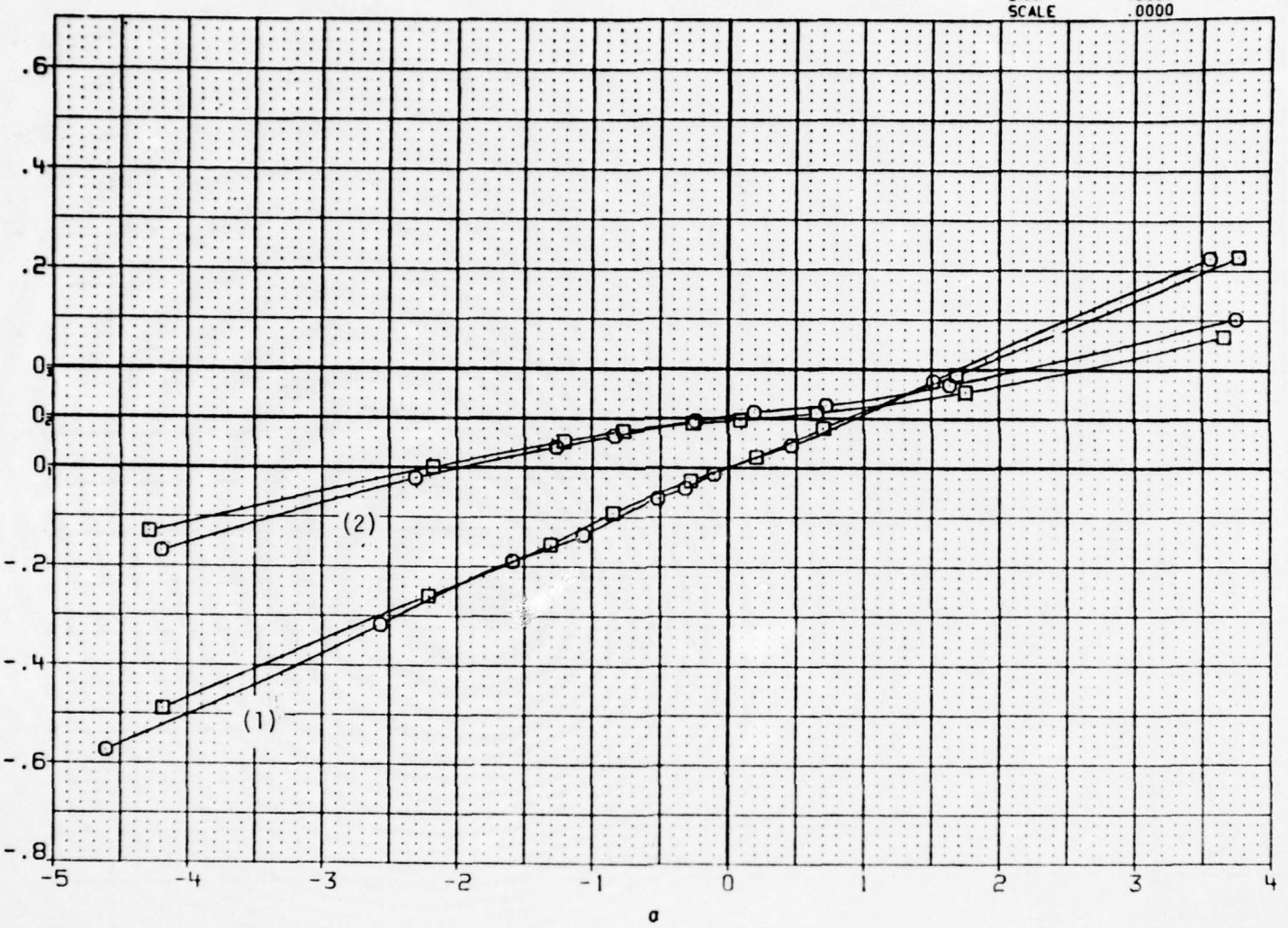


EFFECT OF GAP ON NORMAL FORCE AT VARIOUS THRUST LEVELS

(1) CRT = .02 (2) 5.92

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(DXB018)	○	CAL T17-123 (BF2) BODY, FIN IN FORWARD POSITION	.000	1.000	45.000
(DXB030)	□	CAL T17-123 (BF4) BODY, FIN IN FORWARD POSITION	.250	1.000	45.000

REFERENCE INFORMATION		
SREF	19.6350	SQ.IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	



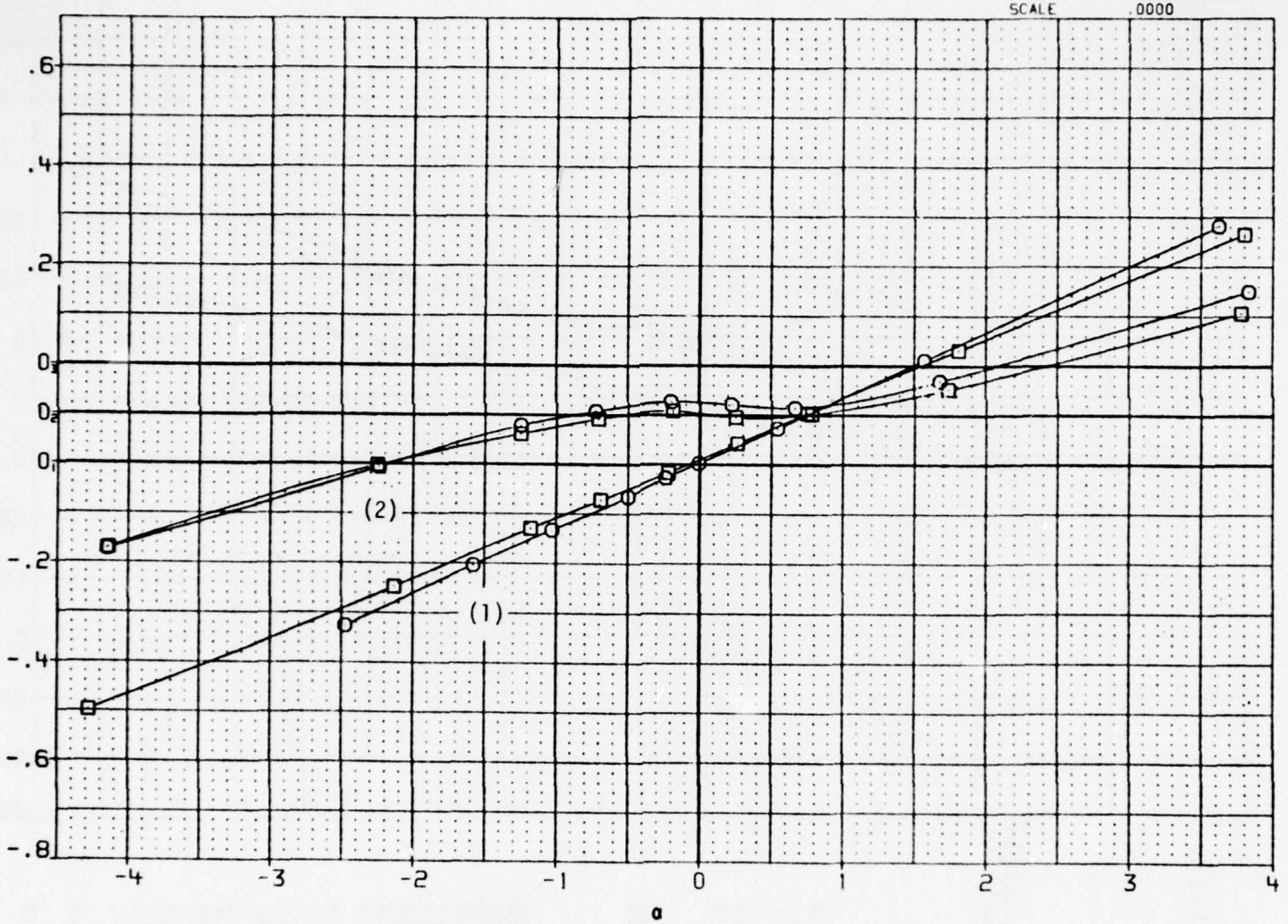
EFFECT OF GAP ON NORMAL FORCE AT VARIOUS THRUST LEVELS

(1) CRT = .03 (2) 5.93

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(GX8019)	○	CAL T17-123 (BF2) BODY, FIN IN FORWARD POSITION	.000	1.200	45.000
(DX8031)	□	CAL T17-123 (BF4) BODY, FIN IN FORWARD POSITION	.250	1.200	45.000

REFERENCE INFORMATION

SREF	19.6350	SQ. IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	



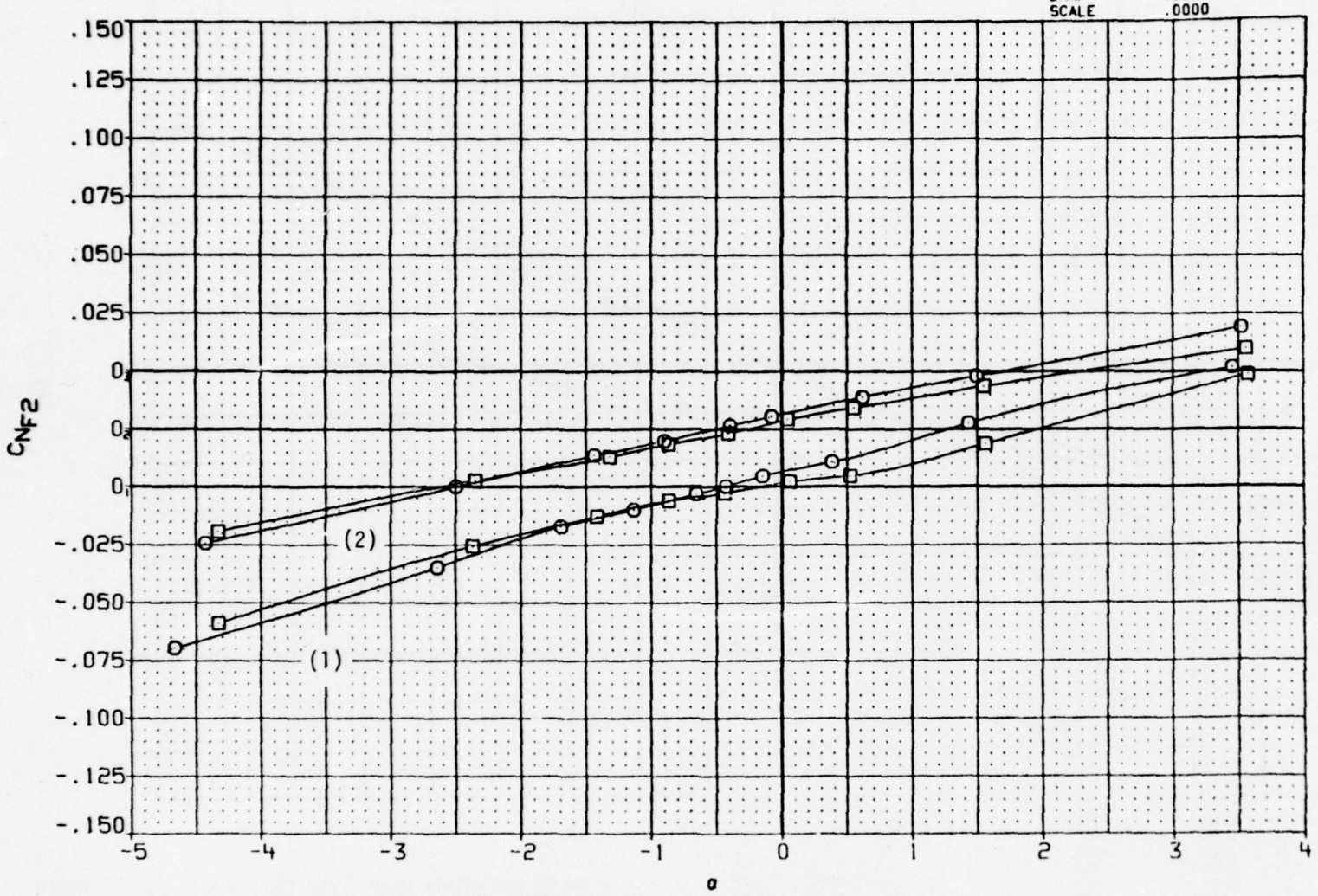
EFFECT OF GAP ON NORMAL FORCE AT VARIOUS THRUST LEVELS

(1) CRT = .01 (2) 5.96

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(EX8017)	○	CAL T17-123 (BF2) BODY, FIN IN FORWARD POSITION	.000	.900	45.000
(DX8029)	□	CAL T17-123 (BF4) BODY, FIN IN FORWARD POSITION	.250	.900	45.000

REFERENCE INFORMATION

SREF	19.6350	SQ. IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	



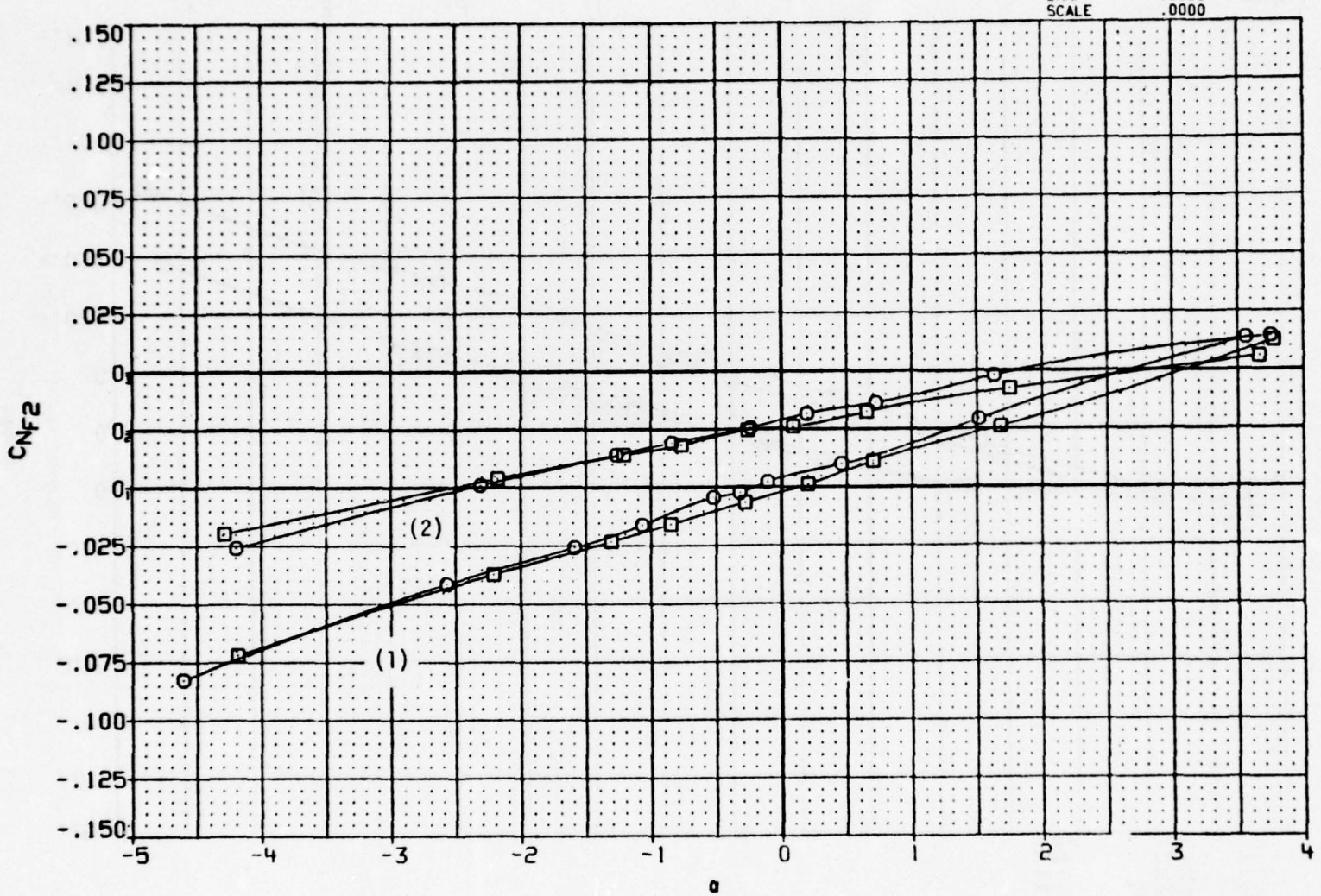
EFFECT OF GAP ON FIN NORMAL FORCE AT VARIOUS THRUST LEVELS

(1) CRT = .02 (2) 5.92

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(DX8018)	○	CAL T17-123 (BF2) BODY, FIN IN FORWARD POSITION	.000	1.000	45.000
(DX8030)	□	CAL T17-123 (BF4) BODY, FIN IN FORWARD POSITION	.250	1.000	45.000

REFERENCE INFORMATION

SREF	19.6350	SQ. IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	



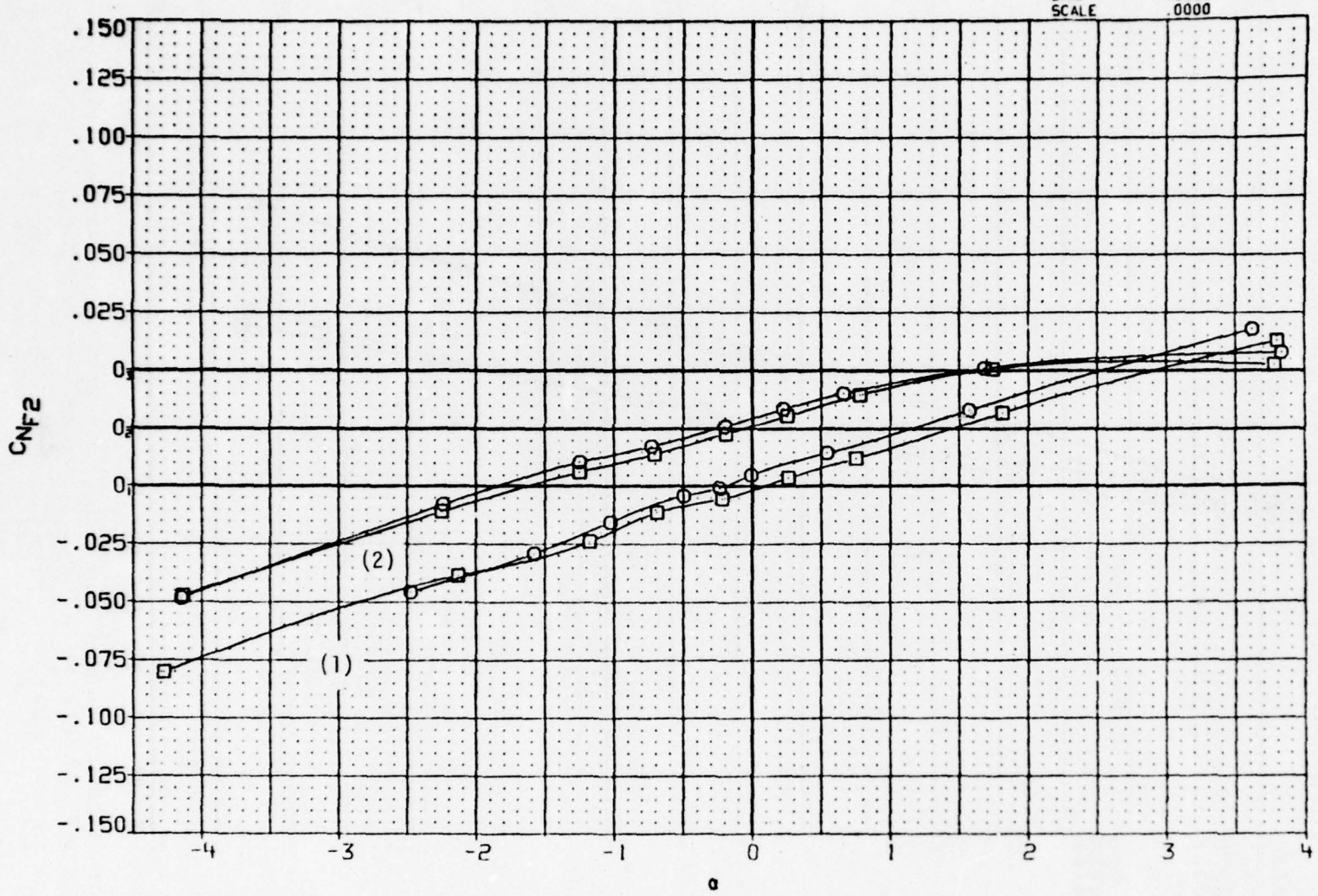
EFFECT OF GAP ON FIN NORMAL FORCE AT VARIOUS THRUST LEVELS

(1) CRT = .03 (2) 5.93

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(0X8019)	○	CAL T17-123 (BF2) BODY, FIN IN FORWARD POSITION	.000	1.200	45.000
(0X8031)	□	CAL T17-123 (BF4) BODY, FIN IN FORWARD POSITION	.250	1.200	45.000

REFERENCE INFORMATION

SREF	19.6350	SQ. IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	



EFFECT OF GAP ON FIN NORMAL FORCE AT VARIOUS THRUST LEVELS

(1) CRT = .01 (2) 5.96

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(EX8067)	○	CAL T17-123 (BF2) BODY, FIN IN AFT POSITION	.000	.700	.000
(OX8063)	□	CAL T17-123 (BF4) BODY, FIN IN AFT POSITION	.250	.700	.000

REFERENCE INFORMATION		
SREF	19.6350	SQ.IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	

EFFECT OF GAP ON NORMAL FORCE AT VARIOUS THRUST LEVELS

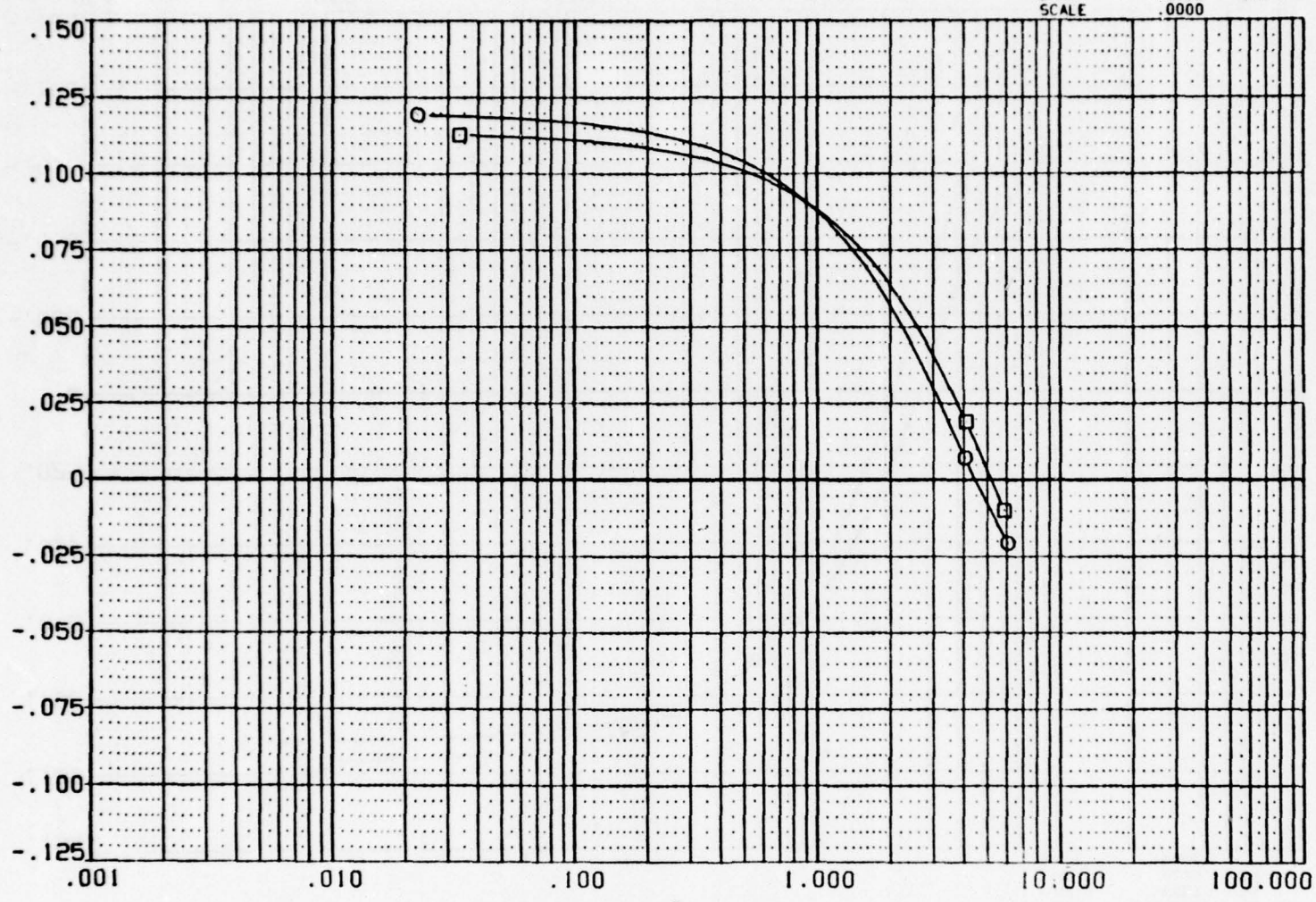
DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(EX8068)	○	CAL T17-123 (BF2) BODY, FIN IN AFT POSITION	.000	.900	.000
(DX8064)	□	CAL T17-123 (BF4) BODY, FIN IN AFT POSITION	.250	.900	.000

REFERENCE INFORMATION		
SREF	19.6350	SQ. IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	

EFFECT OF GAP ON NORMAL FORCE AT VARIOUS THRUST LEVELS

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(EX8069)	○	CAL T17-123 (BF2) BODY, FIN IN AFT POSITION	.000	1.000	.000
(DX8065)	□	CAL T17-123 (BF4) BODY, FIN IN AFT POSITION	.250	1.000	.000

REFERENCE INFORMATION		
SREF	19.6350	SQ. IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	

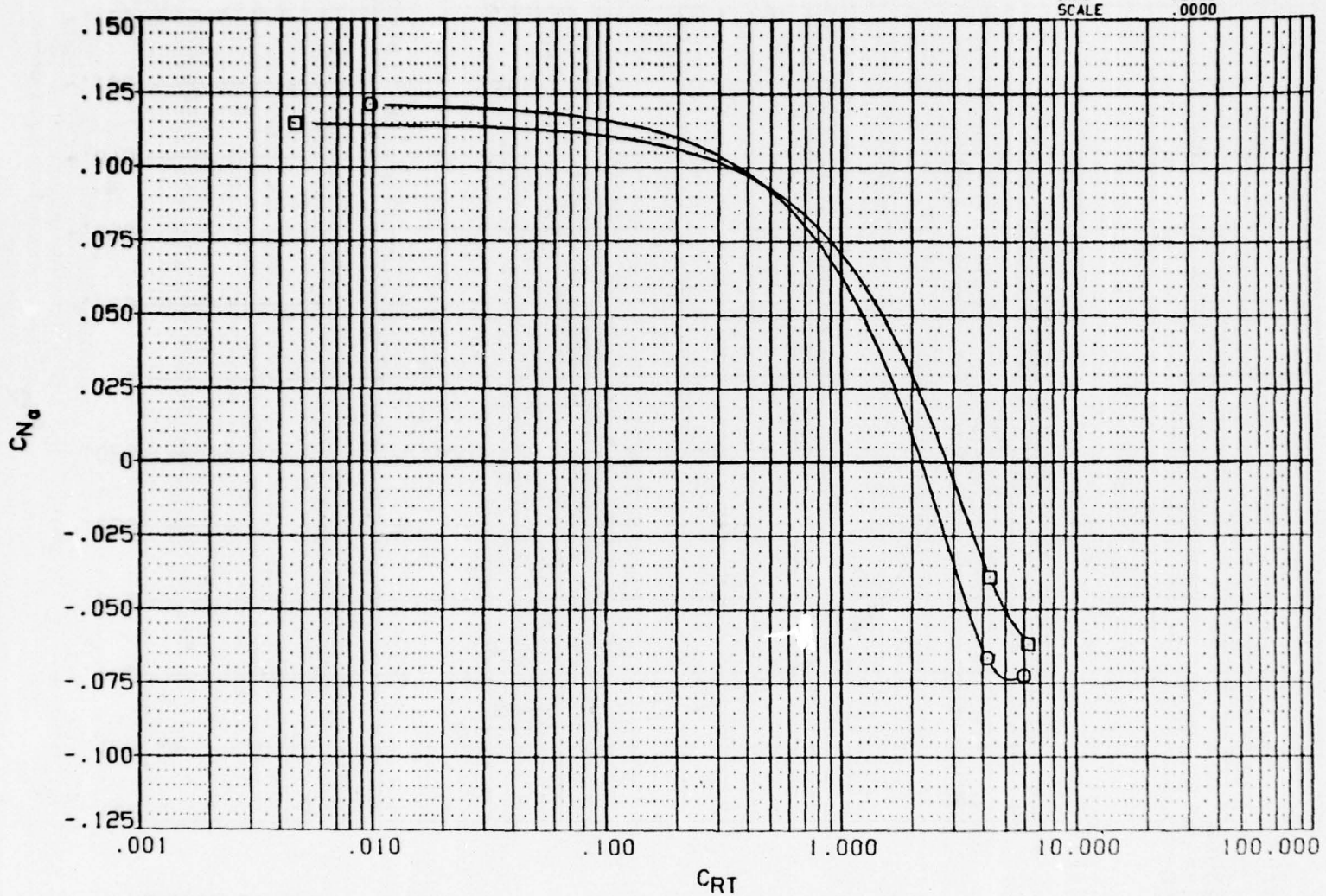


EFFECT OF GAP ON NORMAL FORCE AT VARIOUS THRUST LEVELS

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(EX8070)	○	CAL T17-123 (BF2) BODY, FIN IN AFT POSITION	.000	1.200	.000
(DX8066)	□	CAL T17-123 (BF4) BODY, FIN IN AFT POSITION	.250	1.200	.000

REFERENCE INFORMATION

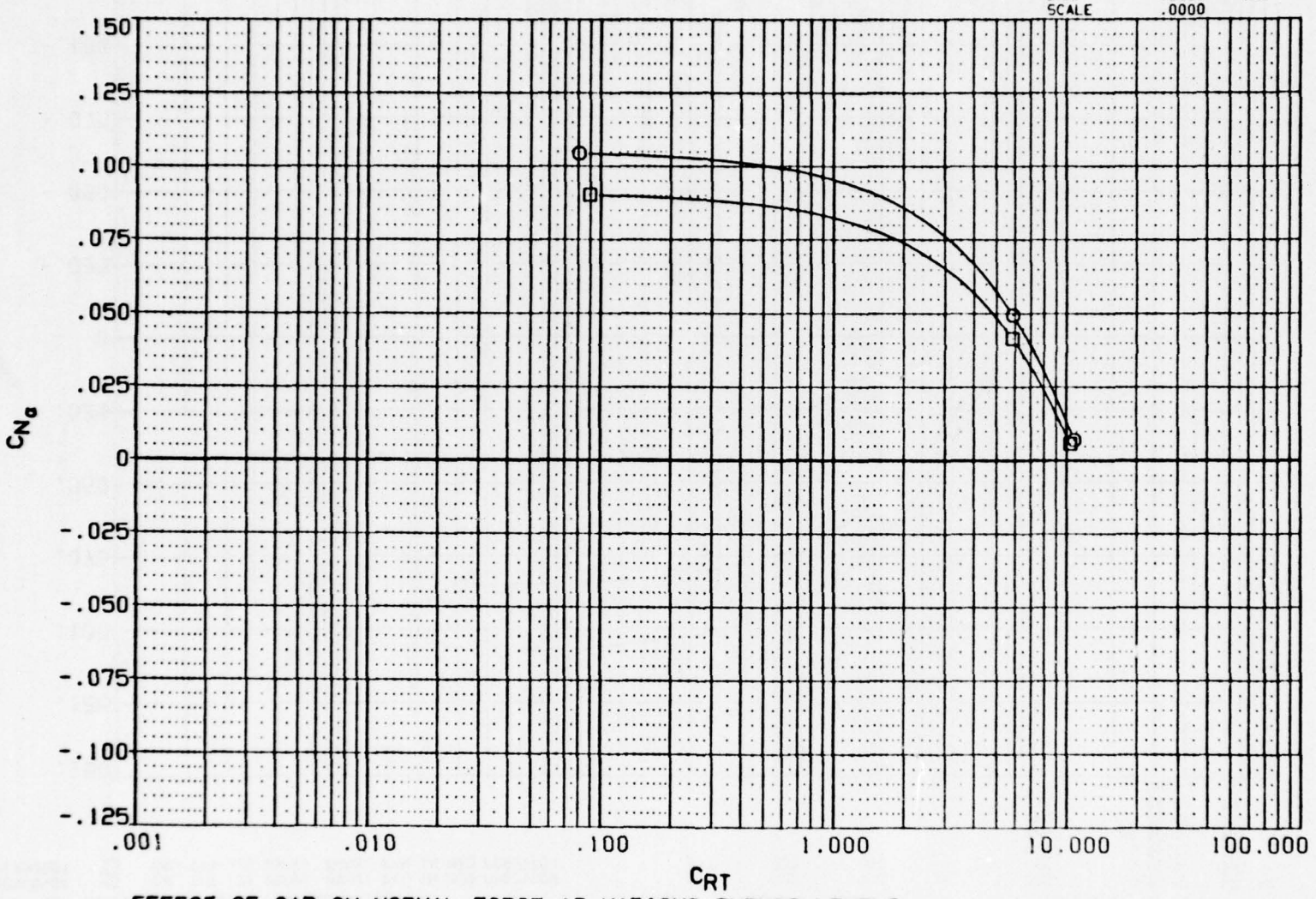
SREF	19.6350	SQ. IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	



EFFECT OF GAP ON NORMAL FORCE AT VARIOUS THRUST LEVELS

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(DX8045)	○	CAL T17-123 (BF2) BODY, FIN IN MID POSITION	.000	.700	.000
(DX8049)	□	CAL T17-123 (BF4) BODY, FIN IN MID POSITION	.250	.700	.000

REFERENCE INFORMATION		
SREF	19.6350	SQ.IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	

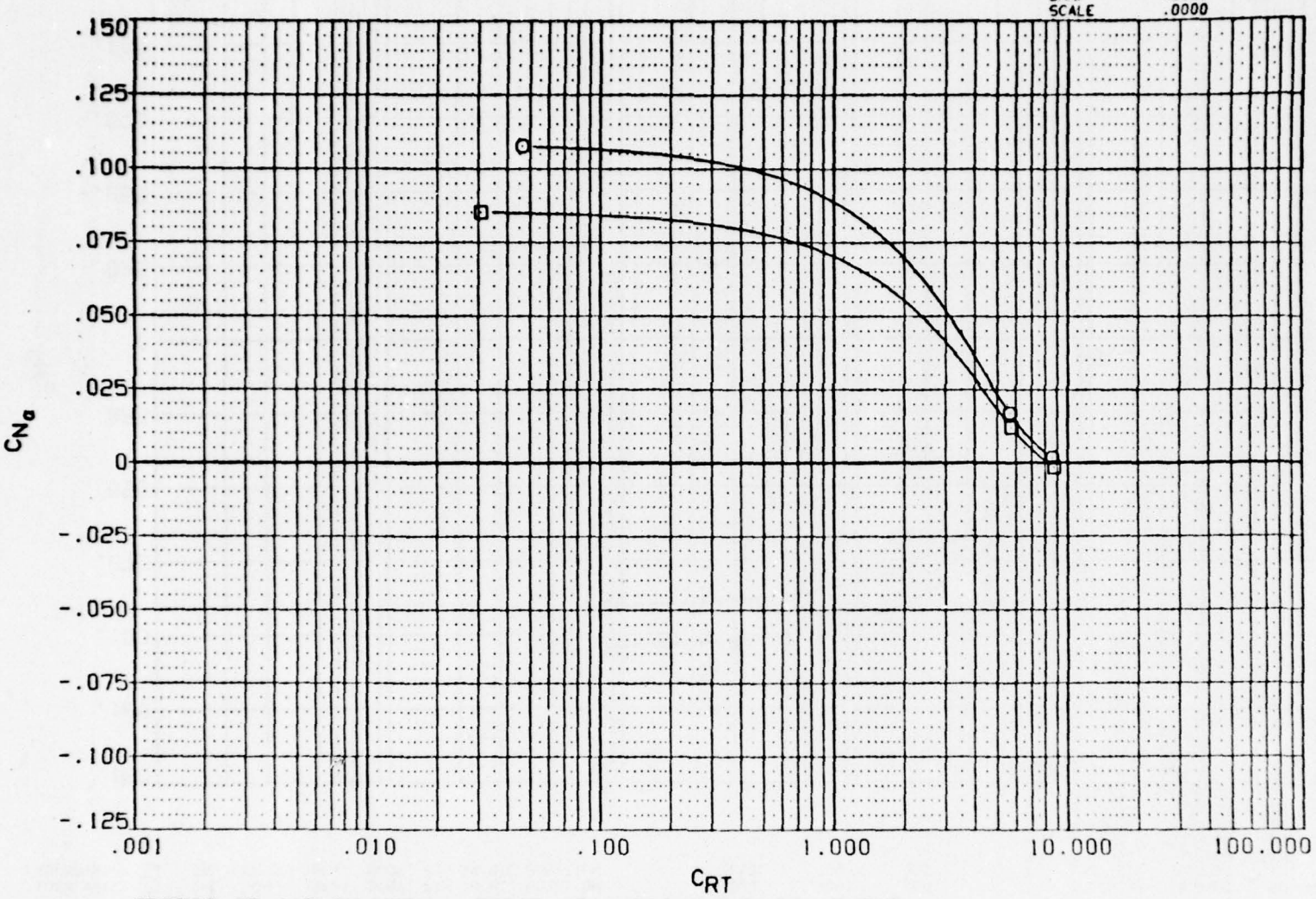


EFFECT OF GAP ON NORMAL FORCE AT VARIOUS THRUST LEVELS

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(DX8046)	○	CAL T17-123 (BF2) BODY, FIN IN MID POSITION	.000	.900	.000
(DX8050)	□	CAL T17-123 (BF4) BODY, FIN IN MID POSITION	.250	.900	.000

REFERENCE INFORMATION

SREF	19.6350	SQ. IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	

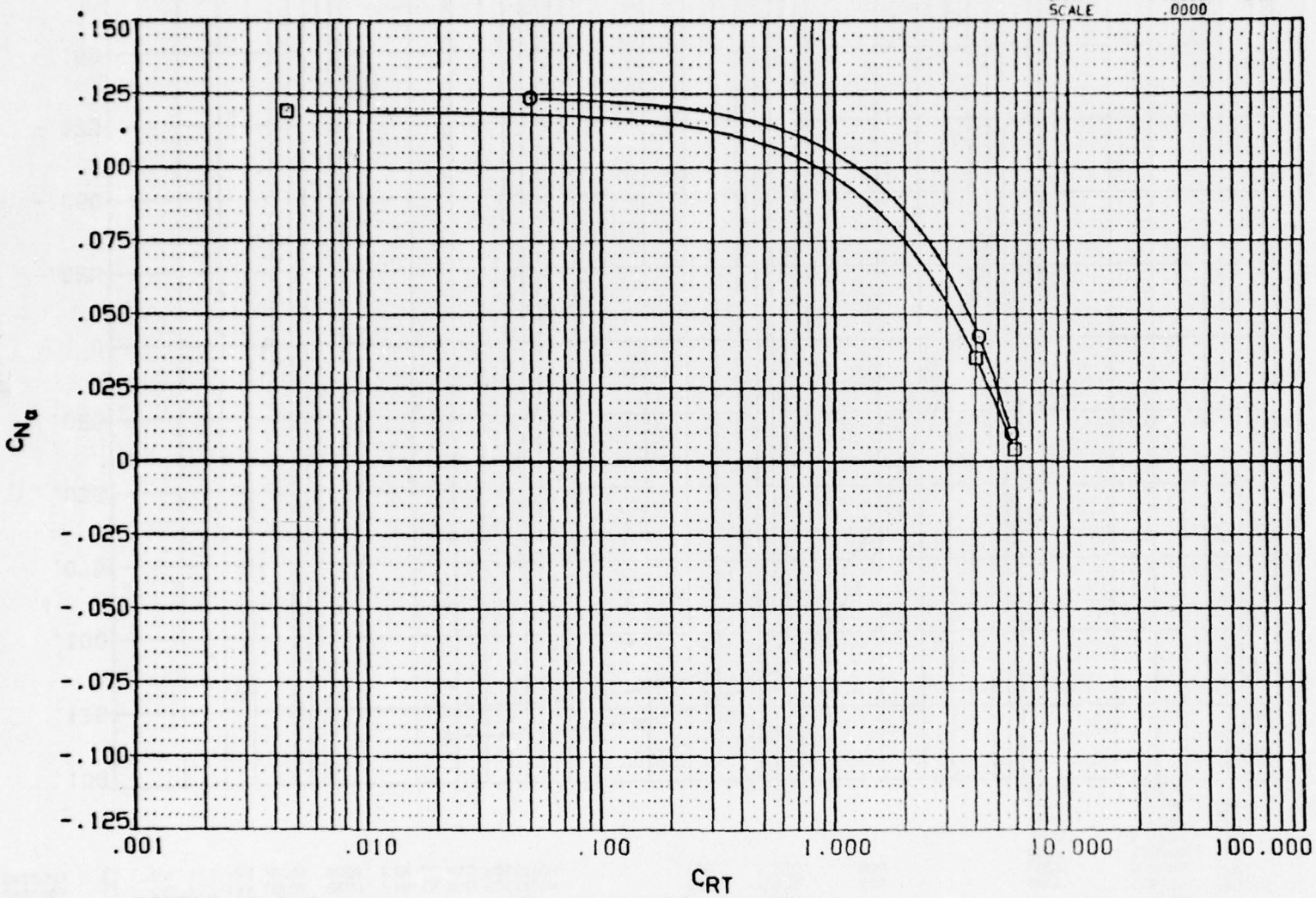


EFFECT OF GAP ON NORMAL FORCE AT VARIOUS THRUST LEVELS

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(DX8047)	○	CAL T17-123 (BF2) BODY, FIN IN MID POSITION	.000	1.000	.000
(DX8051)	□	CAL T17-123 (BF4) BODY, FIN IN MID POSITION	.250	1.000	.000

REFERENCE INFORMATION

SREF	19.6350	SQ. IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	

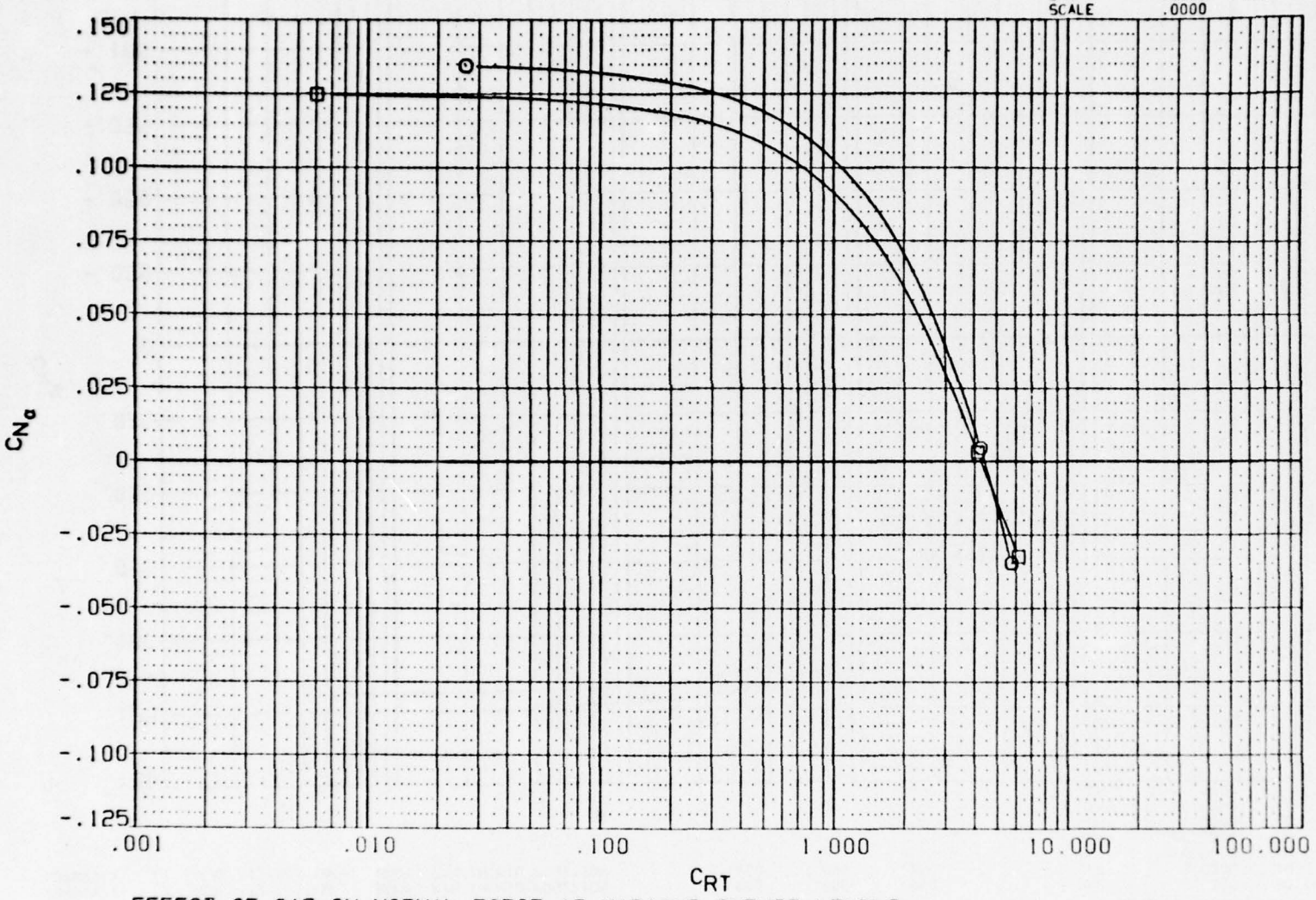


EFFECT OF GAP ON NORMAL FORCE AT VARIOUS THRUST LEVELS

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(DX8048)	○	CAL T17-123 (BF2) BODY, FIN IN MID POSITION	.000	1.200	.000
(DX8052)	□	CAL T17-123 (BF4) BODY, FIN IN MID POSITION	.250	1.200	.000

REFERENCE INFORMATION

SREF	19.6350	SQ. IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	



EFFECT OF GAP ON NORMAL FORCE AT VARIOUS THRUST LEVELS

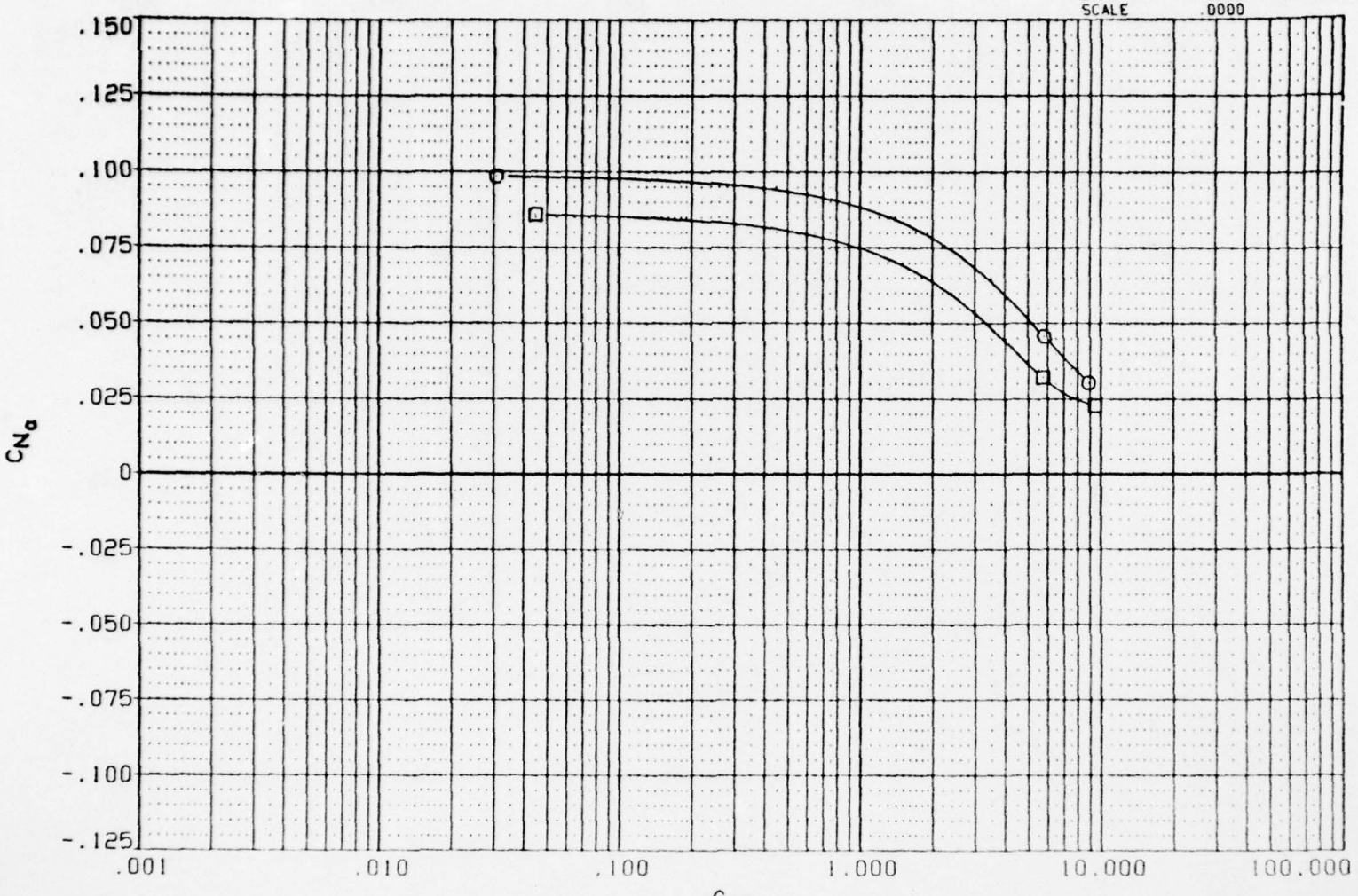
DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(EX8013)	○	CAL T17-123 (BF2) BODY, FIN IN FORWARD POSITION	.000	.700	.000
(DX8025)	□	CAL T17-123 (BF4) BODY, FIN IN FORWARD POSITION	.250	.700	.000

REFERENCE INFORMATION		
SREF	19.6350	SQ. IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	

EFFECT OF GAP ON NORMAL FORCE AT VARIOUS THRUST LEVELS

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(EX8014)	○	CAL T17-123 (BF2) BODY, FIN IN FORWARD POSITION	.000	.900	.000
(DX8026)	□	CAL T17-123 (BF4) BODY, FIN IN FORWARD POSITION	.250	.900	.000

REFERENCE INFORMATION		
SREF	19.6350	SQ. IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	



EFFECT OF GAP ON NORMAL FORCE AT VARIOUS THRUST LEVELS

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(EXB015)	○	CAL T17-123 (BF2) BODY, FIN IN FORWARD POSITION	.000	1.000	.000
(DXB027)	□	CAL T17-123 (BF4) BODY, FIN IN FORWARD POSITION	.250	1.000	.000

REFERENCE INFORMATION

SREF	19.6350	SQ.IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	

EFFECT OF GAP ON NORMAL FORCE AT VARIOUS THRUST LEVELS

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(EX8016)	○	CAL T17-123 (BF2) BODY, FIN IN FORWARD POSITION	.000	1.200	.000
(DX8028)	□	CAL T17-123 (BF4) BODY, FIN IN FORWARD POSITION	.250	1.200	.000

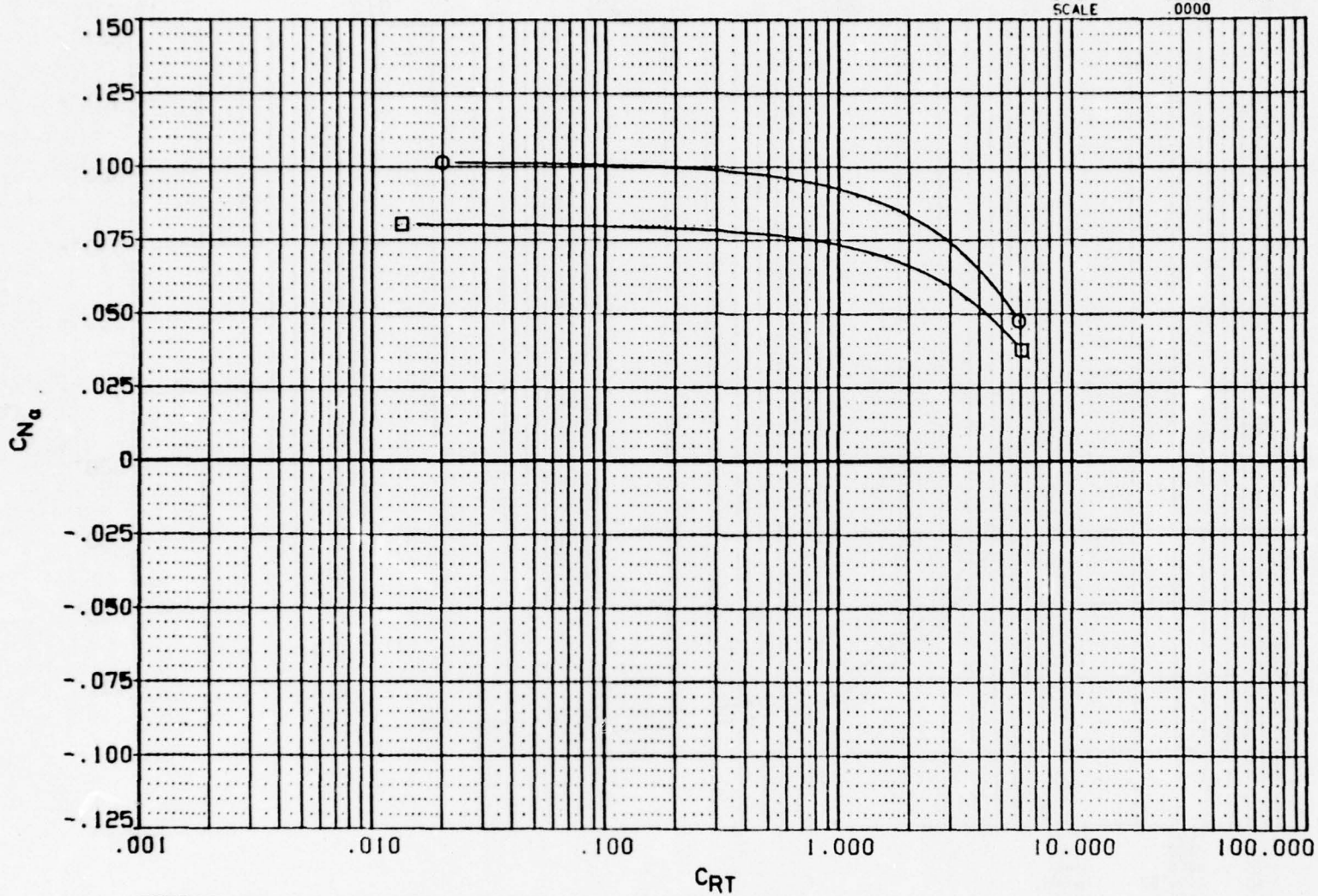
REFERENCE INFORMATION

SREF	19.6350	SQ. IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	

EFFECT OF GAP ON NORMAL FORCE AT VARIOUS THRUST LEVELS

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(EX8017)	○	CAL T17-123 (BF2) BODY, FIN IN FORWARD POSITION	.000	.900	45.000
(DX8029)	□	CAL T17-123 (BF4) BODY, FIN IN FORWARD POSITION	.250	.900	45.000

REFERENCE INFORMATION		
SREF	19.6350	SQ. IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	

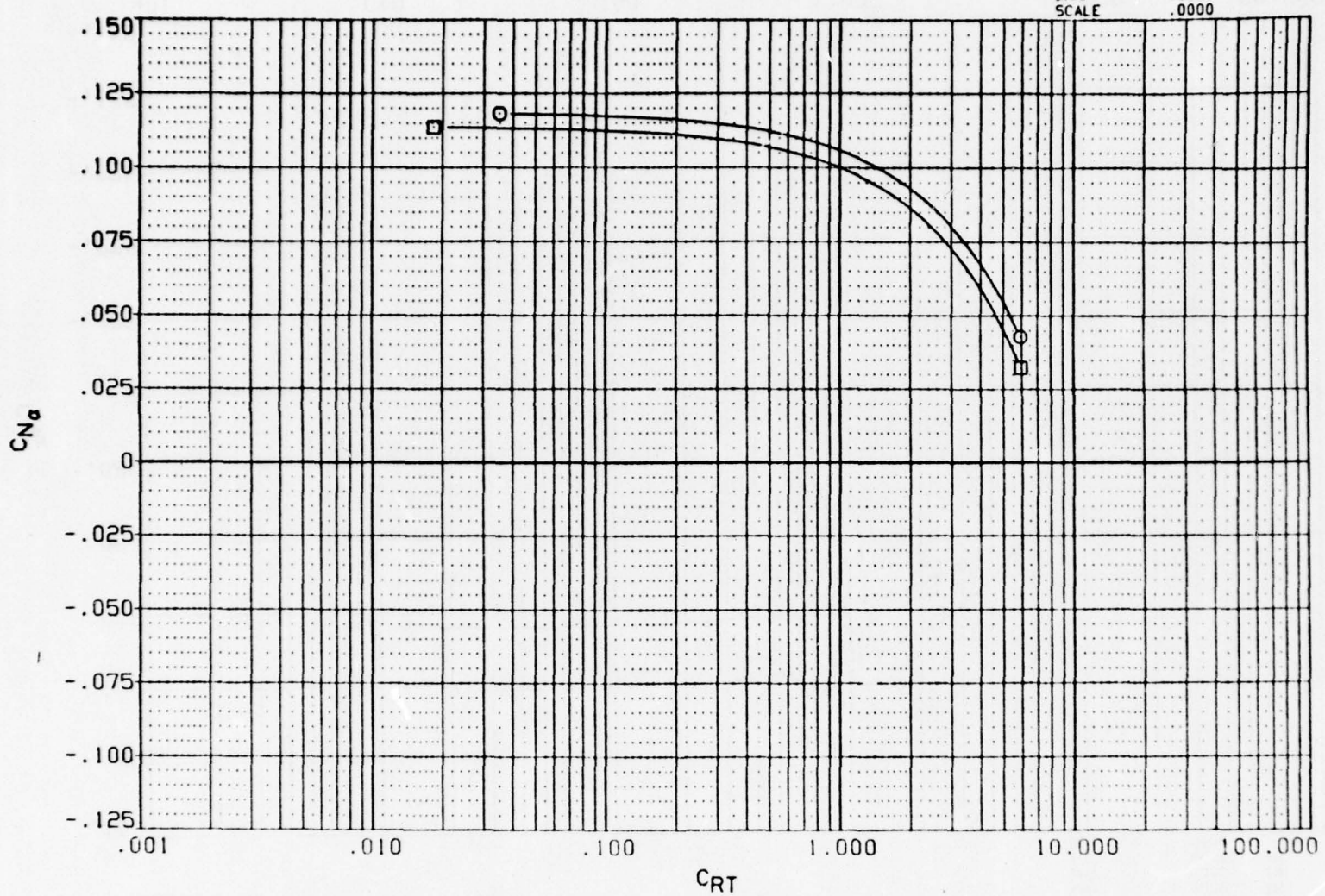


EFFECT OF GAP ON NORMAL FORCE AT VARIOUS THRUST LEVELS

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(DX8018)	○	CAL T17-123 (BF2) BODY, FIN IN FORWARD POSITION	.000	1.000	45.000
(DX8030)	□	CAL T17-123 (BF4) BODY, FIN IN FORWARD POSITION	.250	1.000	45.000

REFERENCE INFORMATION

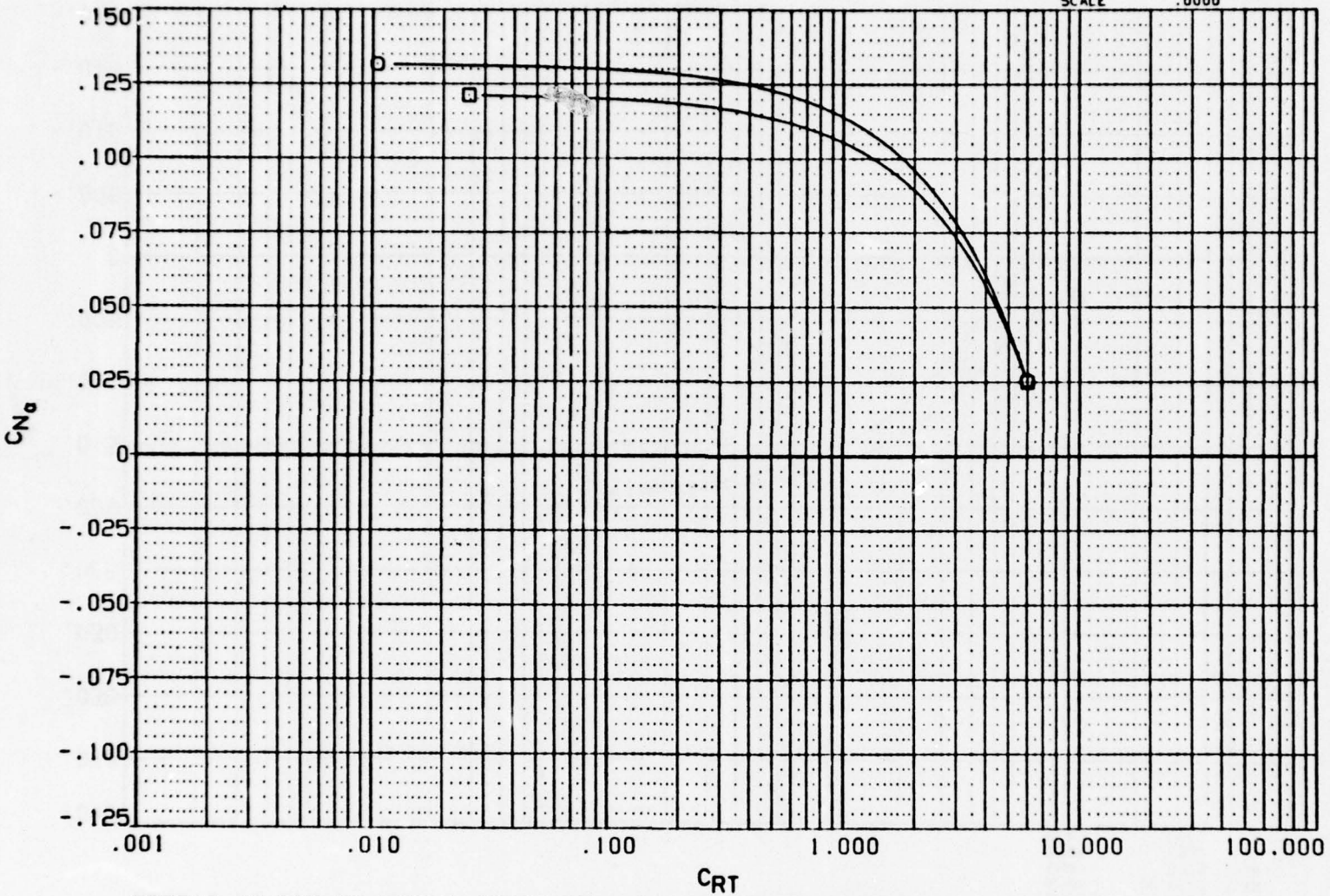
SREF	19.6350	SQ. IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	



EFFECT OF GAP ON NORMAL FORCE AT VARIOUS THRUST LEVELS

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(GX8019)	O	CAL T17-123 (BF2) BODY, FIN IN FORWARD POSITION	.000	1.200	45.000
(DX8031)	□	CAL T17-123 (BF4) BODY, FIN IN FORWARD POSITION	.250	1.200	45.000

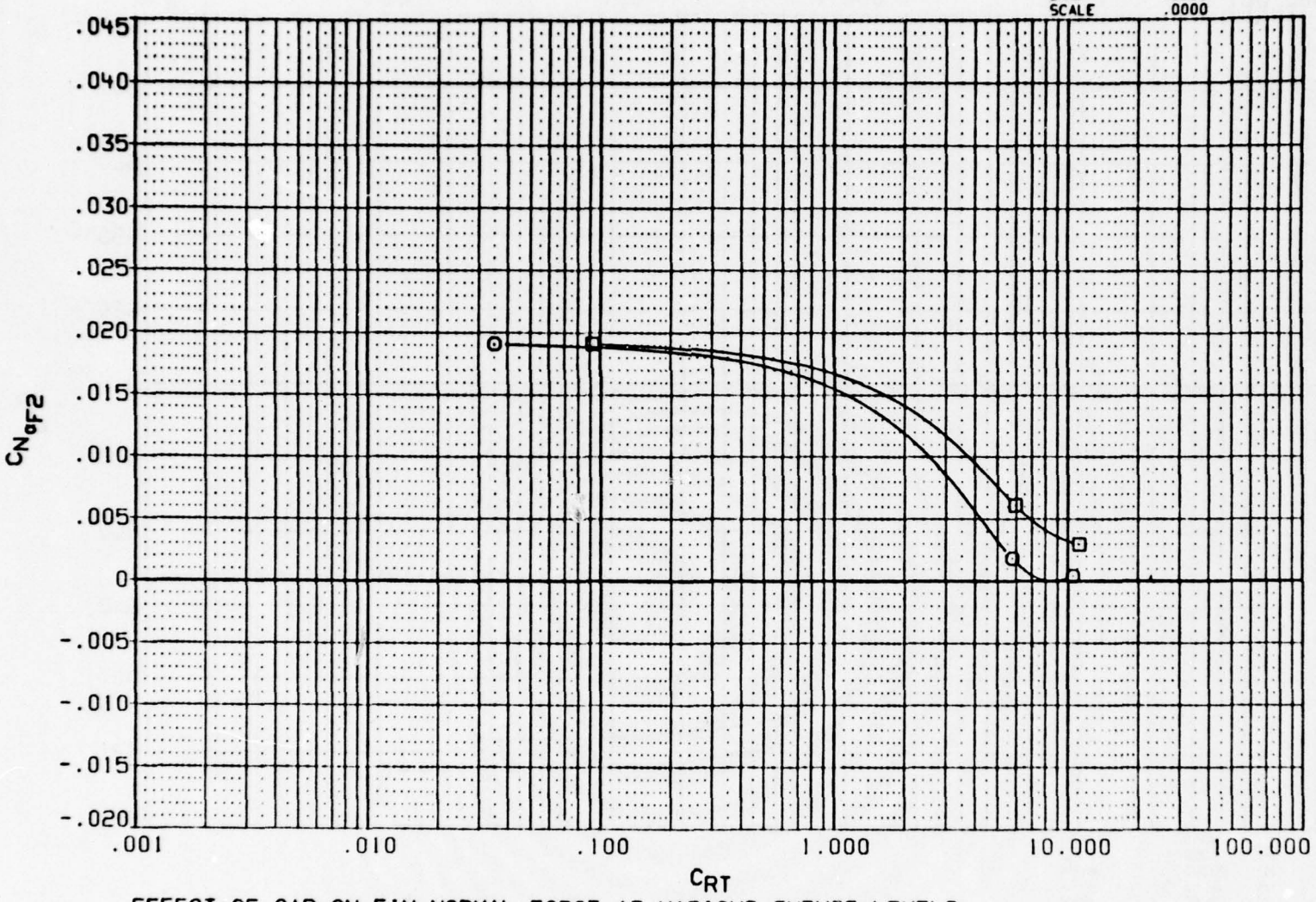
REFERENCE INFORMATION		
SREF	19.6350	SQ.IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	



EFFECT OF GAP ON NORMAL FORCE AT VARIOUS THRUST LEVELS

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(EX8067)	○	CAL T17-123 (BF2) BODY, FIN IN AFT POSITION	.000	.700	.000
(DX8063)	□	CAL T17-123 (BF4) BODY, FIN IN AFT POSITION	.250	.700	.000

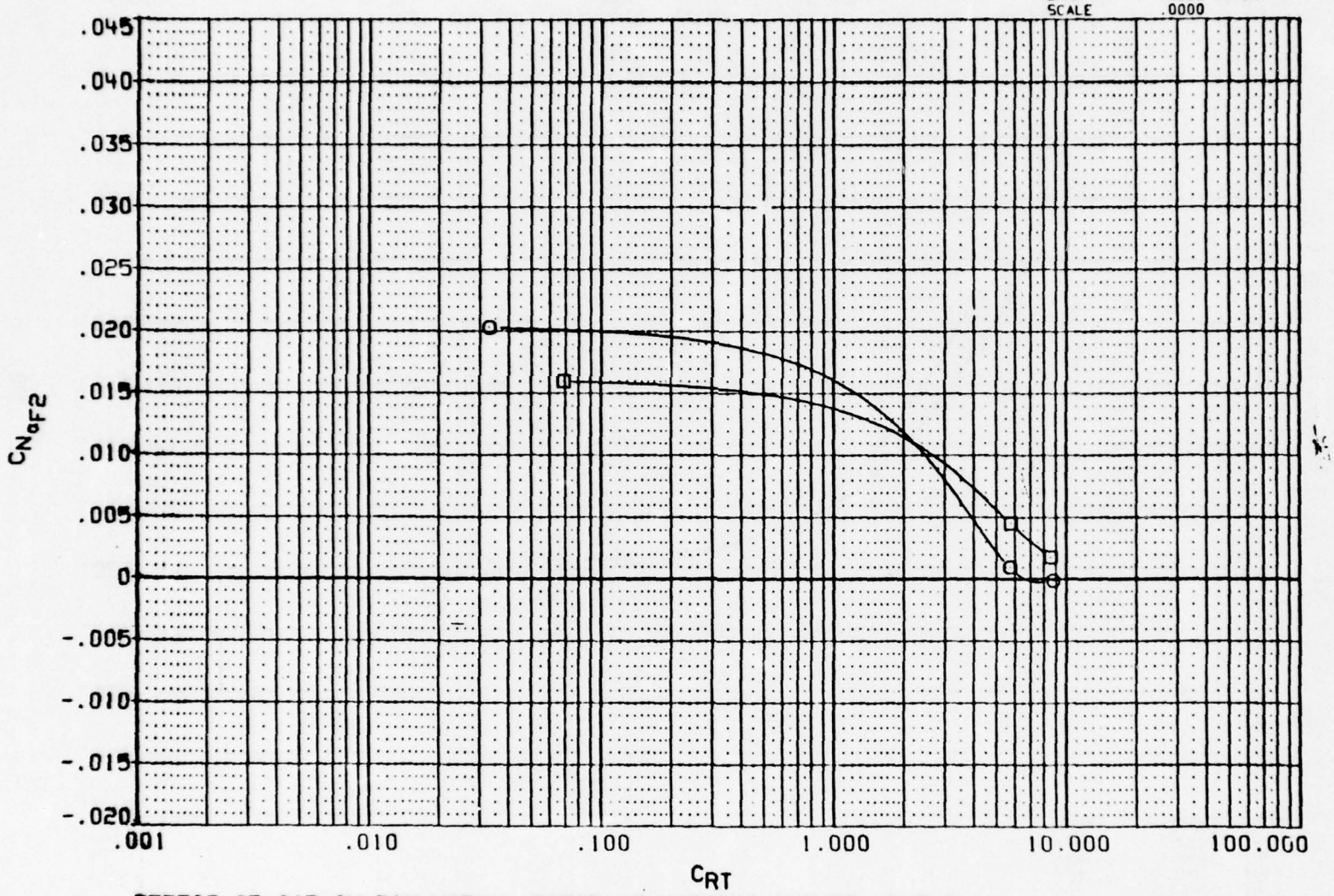
REFERENCE INFORMATION		
SREF	19.6350	SQ. IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	



EFFECT OF GAP ON FIN NORMAL FORCE AT VARIOUS THRUST LEVELS

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(EX8068)	O	CAL T17-123 (BF2) BODY, FIN IN AFT POSITION	.000	.900	.000
(DX8064)	□	CAL T17-123 (BF4) BODY, FIN IN AFT POSITION	.250	.900	.000

REFERENCE INFORMATION		
SREF	19.6350	SQ. IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	

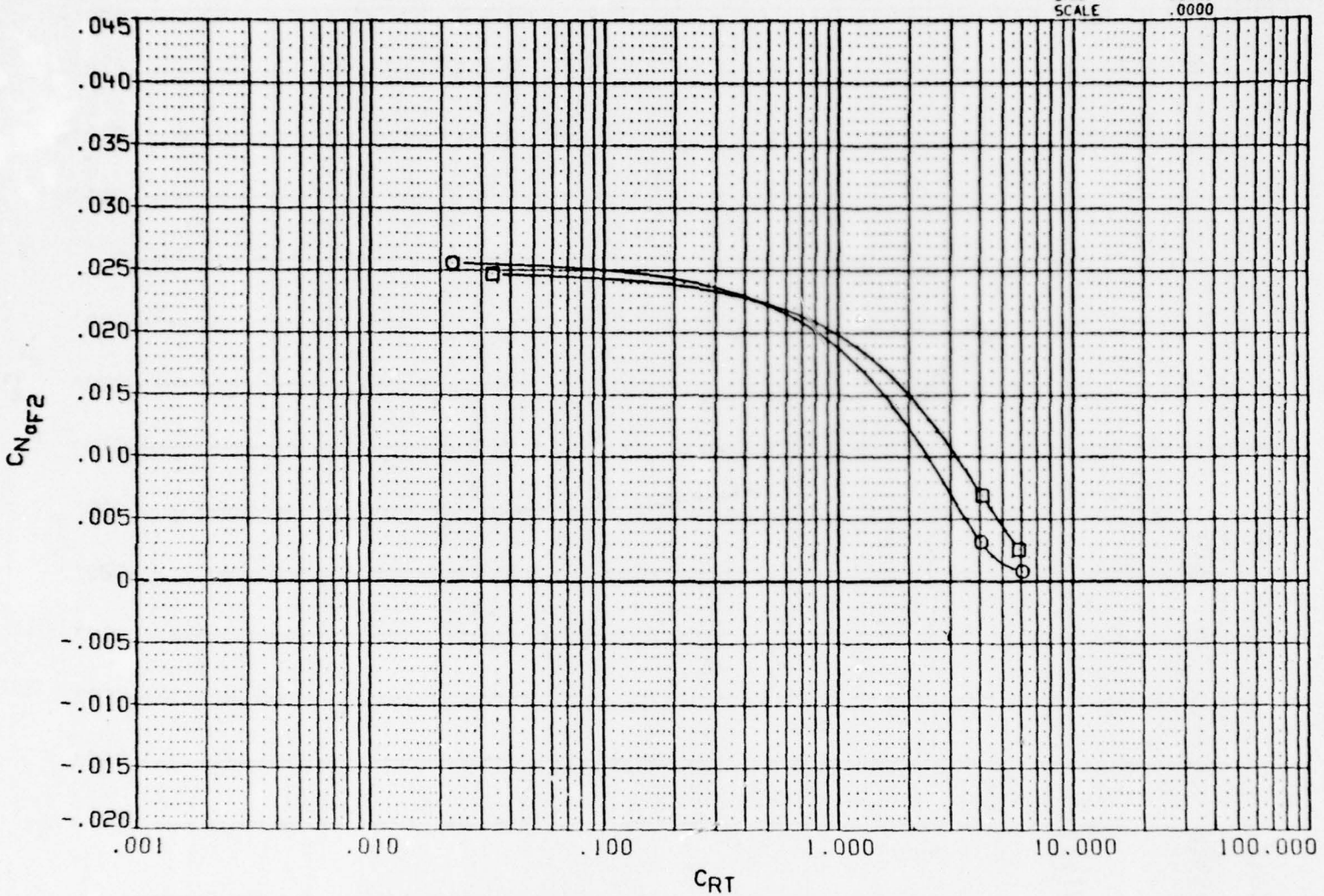


EFFECT OF GAP ON FIN NORMAL FORCE AT VARIOUS THRUST LEVELS

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(EX8069)	8	CAL T17-123 (BF2) BODY, FIN IN AFT POSITION	.000	1.000	.000
(DX8065)	8	CAL T17-123 (BF4) BODY, FIN IN AFT POSITION	.250	1.000	.000

REFERENCE INFORMATION

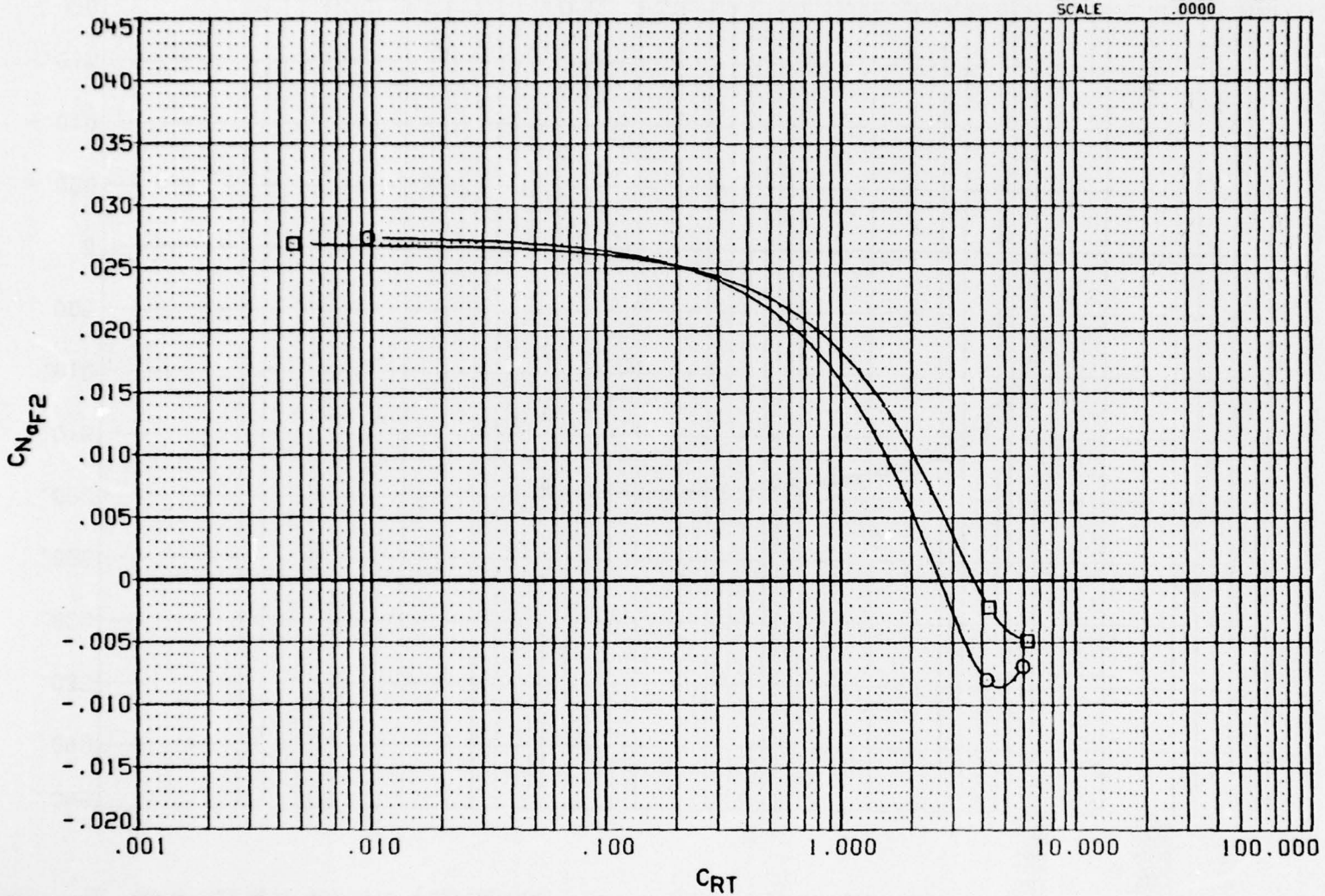
SREF	19.6350	SQ.IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	



EFFECT OF GAP ON FIN NORMAL FORCE AT VARIOUS THRUST LEVELS

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(EX8070)	○	CAL T17-123 (BF2) BODY, FIN IN AFT POSITION	.000	1.200	.000
(DX8066)	□	CAL T17-123 (BF4) BODY, FIN IN AFT POSITION	.250	1.200	.000

REFERENCE INFORMATION		
SREF	19.6350	SQ. IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	



EFFECT OF GAP ON FIN NORMAL FORCE AT VARIOUS THRUST LEVELS

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(DX8045)	○	CAL T17-123 (BF2) BODY, FIN IN MID POSITION	.000	.700	.000
(DX8049)	□	CAL T17-123 (BF4) BODY, FIN IN MID POSITION	.250	.700	.000

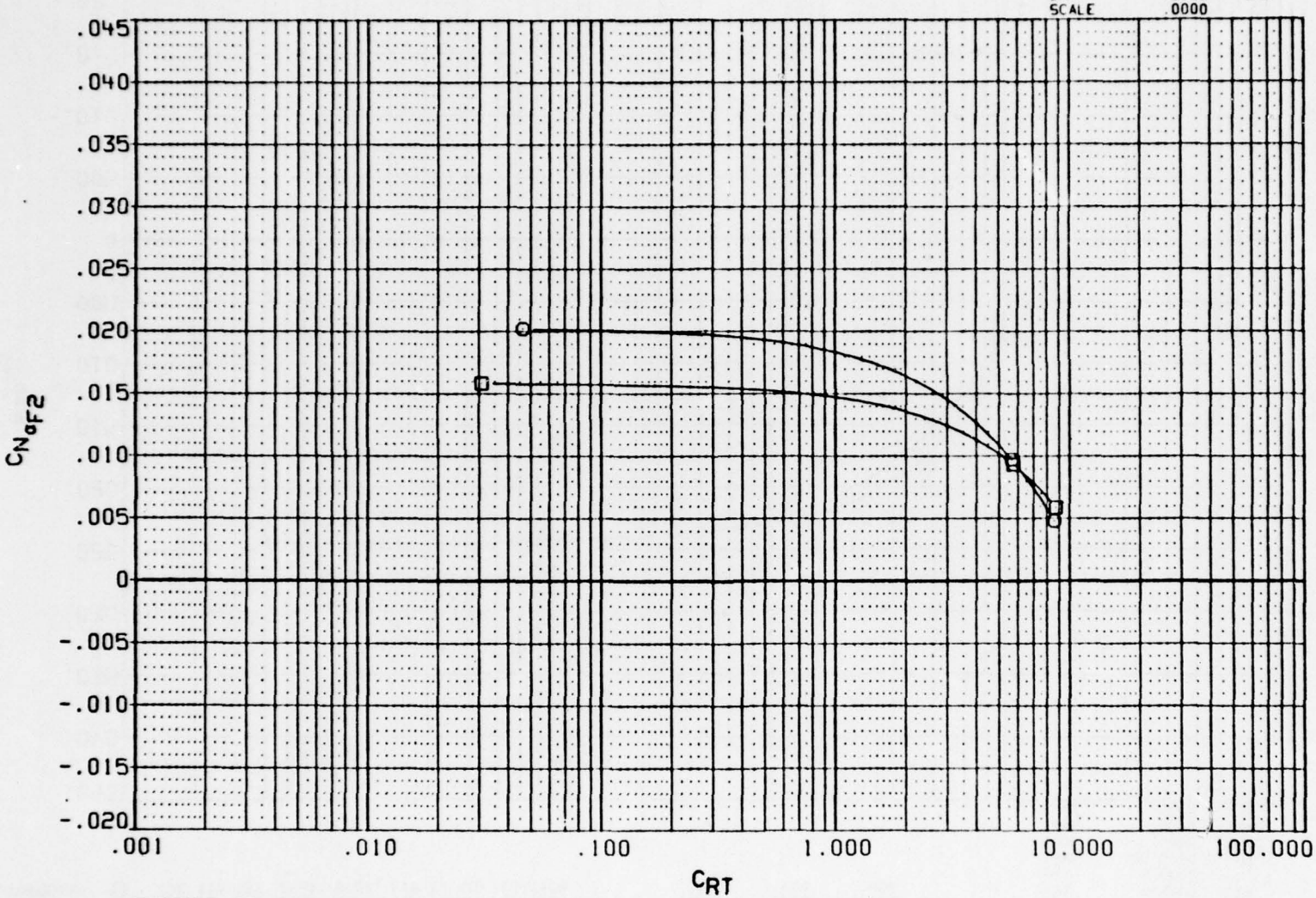
REFERENCE INFORMATION		
SREF	19.6350	SQ. IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	

EFFECT OF GAP ON FIN NORMAL FORCE AT VARIOUS THRUST LEVELS

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(DX8046)	○	CAL T17-123 (BF2) BODY, FIN IN MID POSITION	.000	.900	.000
(DX8050)	□	CAL T17-123 (BF4) BODY, FIN IN MID POSITION	.250	.900	.000

REFERENCE INFORMATION

SREF	19.6350	SQ. IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	

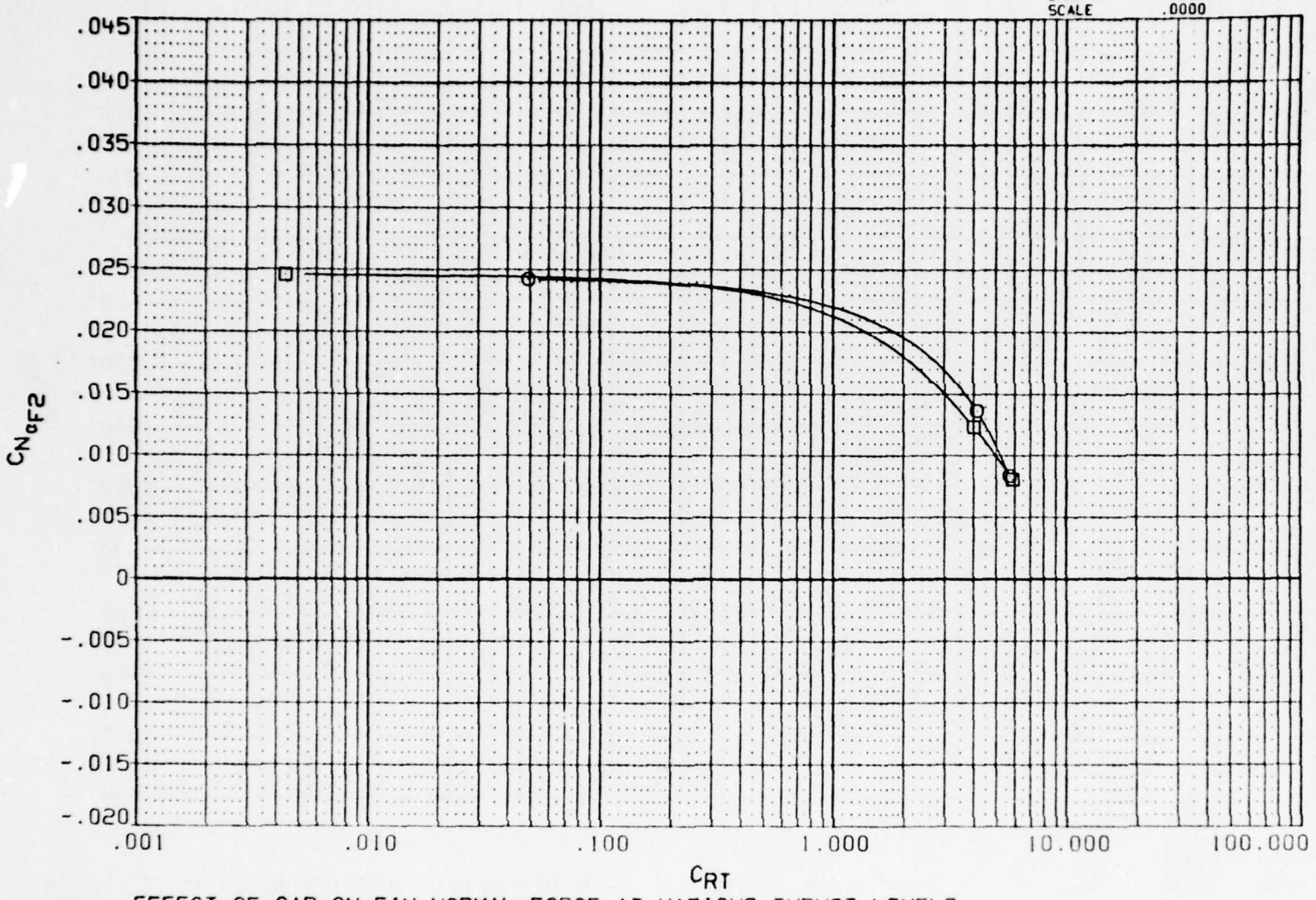


EFFECT OF GAP ON FIN NORMAL FORCE AT VARIOUS THRUST LEVELS

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(DX8047)	○	CAL T17-123 (BF2) BODY, FIN IN MID POSITION	.000	1.000	.000
(DX8051)	□	CAL T17-123 (BF4) BODY, FIN IN MID POSITION	.250	1.000	.000

REFERENCE INFORMATION

SREF	19.6350	SQ. IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	

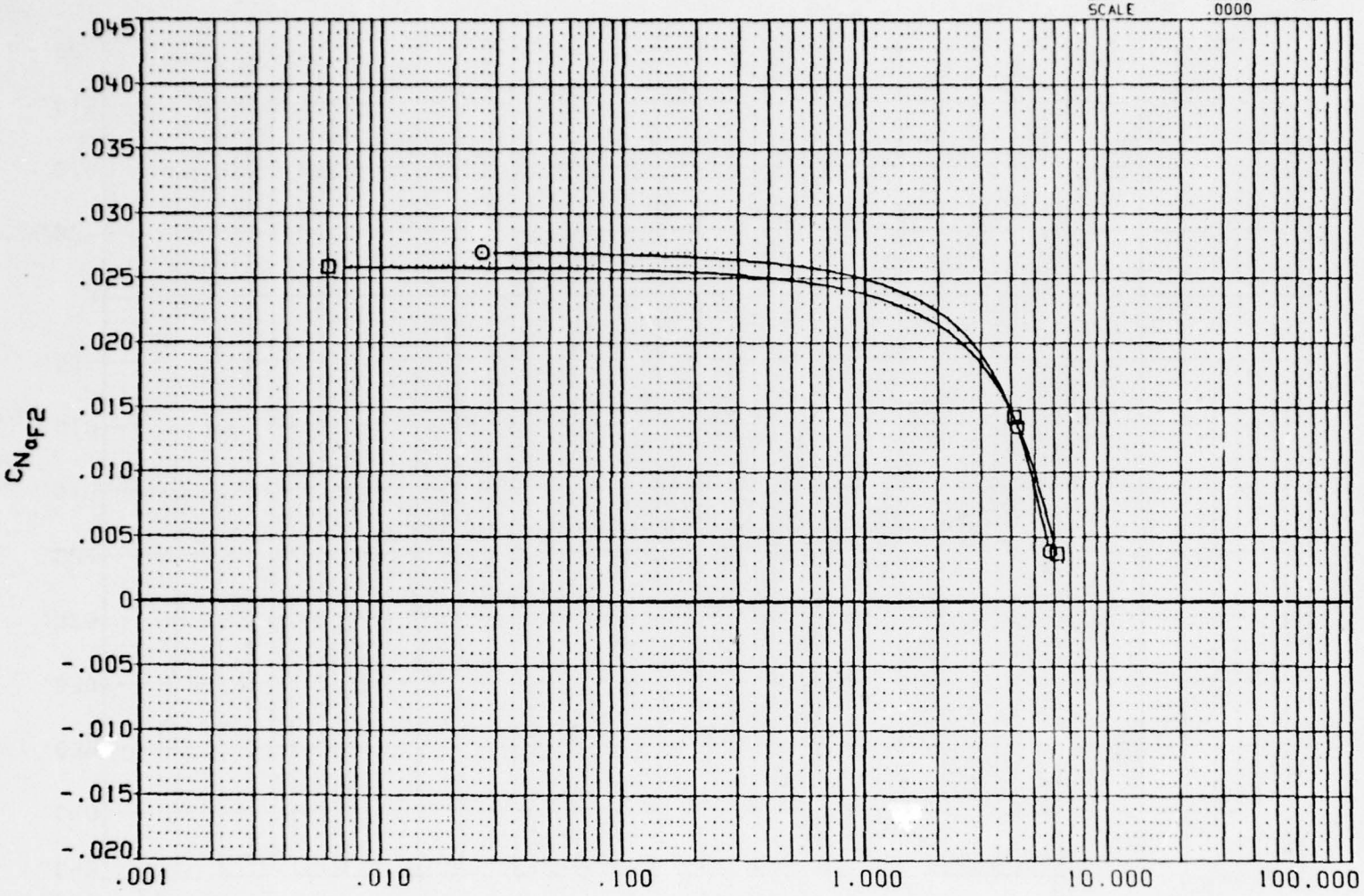


EFFECT OF GAP ON FIN NORMAL FORCE AT VARIOUS THRUST LEVELS

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(DX8048)	O	CAL T17-123 (BF2) BODY, FIN IN MID POSITION	.000	1.200	.000
(DX8052)	□	CAL T17-123 (BF4) BODY, FIN IN MID POSITION	.250	1.200	.000

REFERENCE INFORMATION

SREF	19.6350	SQ. IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	



EFFECT OF GAP ON FIN NORMAL FORCE AT VARIOUS THRUST LEVELS

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(EX8013)	○	CAL T17-123 (BF2) BODY, FIN IN FORWARD POSITION	.000	.700	.000
(DX8025)	□	CAL T17-123 (BF4) BODY, FIN IN FORWARD POSITION	.250	.700	.000

REFERENCE INFORMATION		
SREF	19.6350	SQ. IN.
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XMRP	26.5000	IN.
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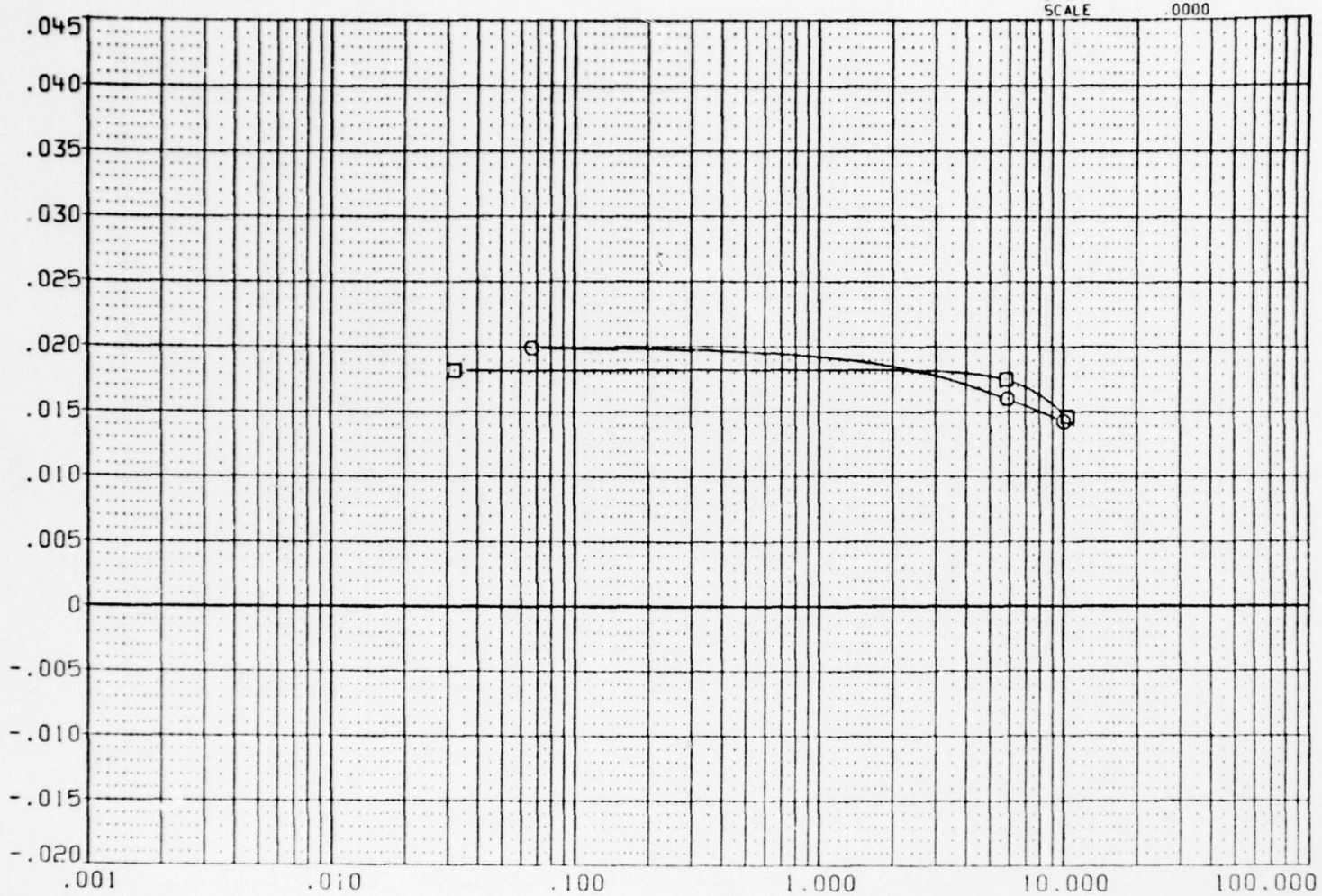

EFFECT OF GAP ON FIN NORMAL FORCE AT VARIOUS THRUST LEVELS

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(EX8014)	⊗	CAL T17-123 (BF2) BODY, FIN IN FORWARD POSITION	.000	.900	.000
(DX8026)	□	CAL T17-123 (BF4) BODY, FIN IN FORWARD POSITION	.250	.900	.000

REFERENCE INFORMATION		
SREF	19.6350	SQ. IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
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YMRP	.0000	IN.
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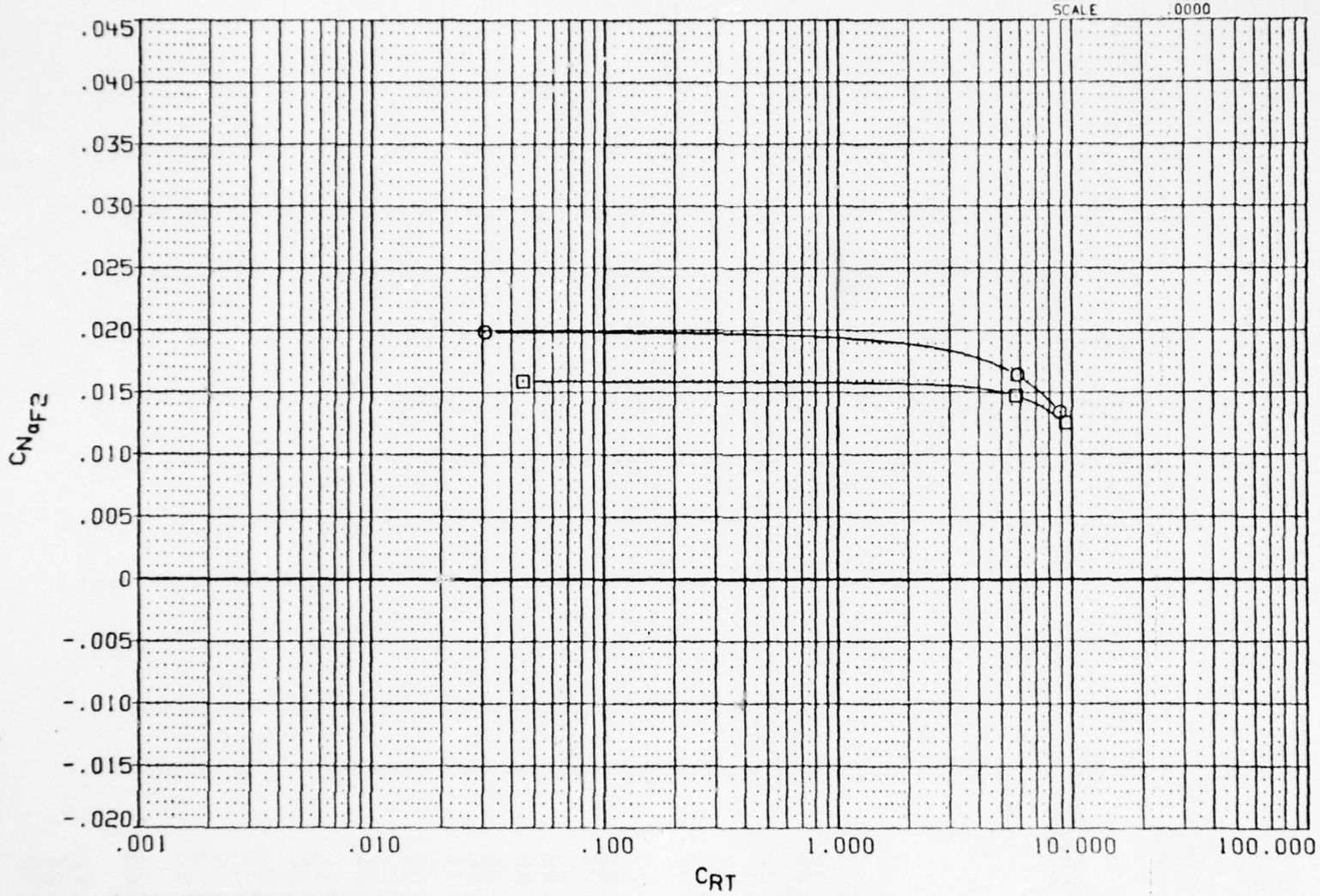
SCALE	.0000	

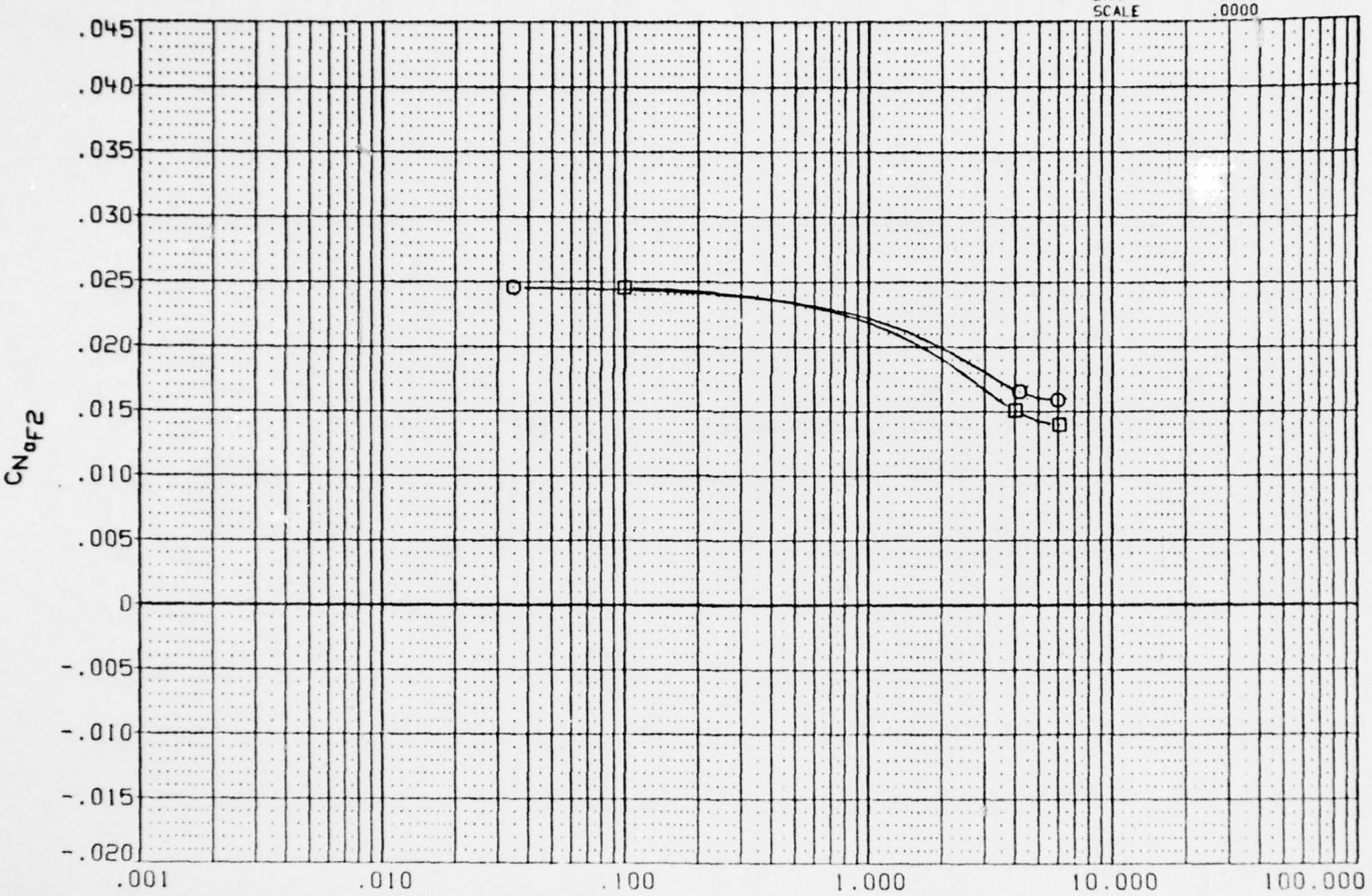


EFFECT OF GAP ON FIN NORMAL FORCE AT VARIOUS THRUST LEVELS

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(EX8015)	○	CAL T17-123 (BF2) BODY, FIN IN FORWARD POSITION	.000	1.000	.000
(DX8027)	□	CAL T17-123 (BF4) BODY, FIN IN FORWARD POSITION	.250	1.000	.000

REFERENCE INFORMATION

SREF	19.6350	SQ. IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	



EFFECT OF GAP ON FIN NORMAL FORCE AT VARIOUS THRUST LEVELS

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(EX8016)	○	CAL T17-123 (BF2) BODY, FIN IN FORWARD POSITION	.000	1.200	.000
(DX8028)	□	CAL T17-123 (BF4) BODY, FIN IN FORWARD POSITION	.250	1.200	.000

REFERENCE INFORMATION

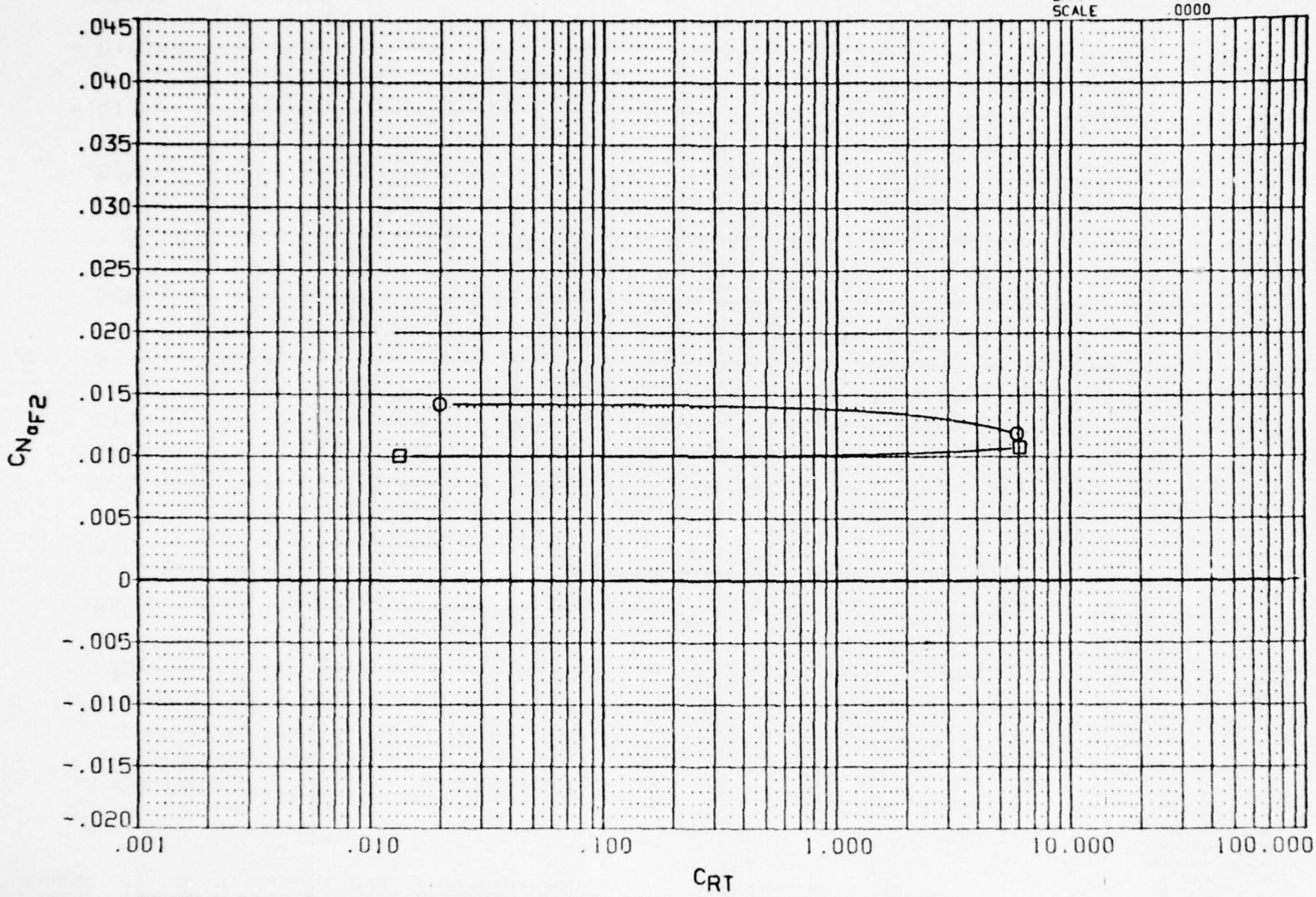
SREF	19.6350	SQ. IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	

EFFECT OF GAP ON FIN NORMAL FORCE AT VARIOUS THRUST LEVELS

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(EX8017)	○	CAL T17-123 (BF2) BODY, FIN IN FORWARD POSITION	.000	.900	45.000
(DX8029)	□	CAL T17-123 (BF4) BODY, FIN IN FORWARD POSITION	.250	.900	45.000

REFERENCE INFORMATION

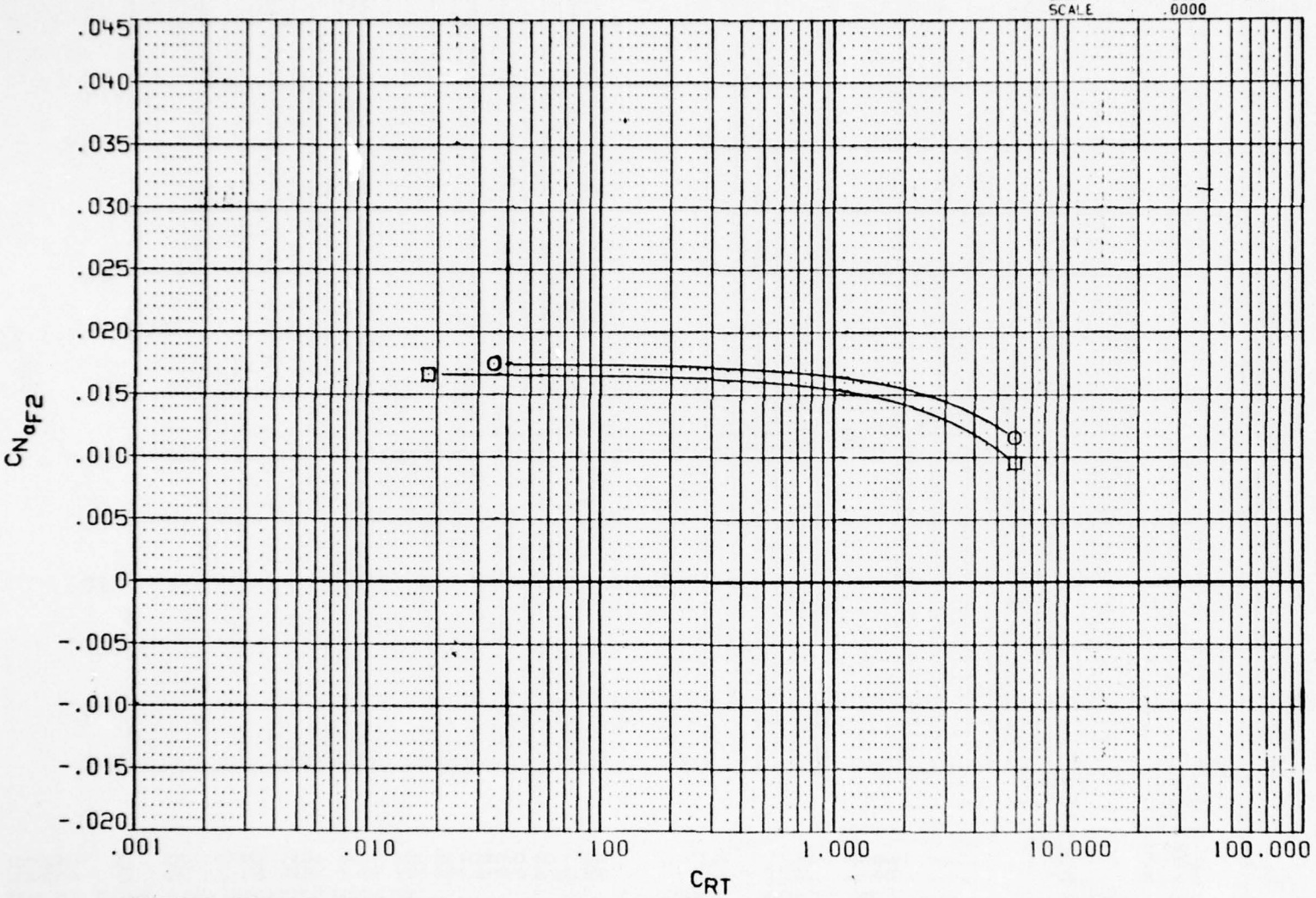
SREF	19.6350	SQ. IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	



EFFECT OF GAP ON FIN NORMAL FORCE AT VARIOUS THRUST LEVELS

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(DX8018)	○	CAL T17-12 (BF2) BODY, FIN IN FORWARD POSITION	.000	1.000	45.000
(DX8030)	□	CAL T17-12 (BF4) BODY, FIN IN FORWARD POSITION	.250	1.000	45.000

REFERENCE INFORMATION		
SREF	19.6350	SQ. IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	



EFFECT OF GAP ON FIN NORMAL FORCE AT VARIOUS THRUST LEVELS

DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	GAP	MACH	PHI
(GXB019)	O	CAL T17-123 (BF2) BODY, FIN IN FORWARD POSITION	.000	1.200	45.000
(DXB031)	□	CAL T17-123 (BF4) BODY, FIN IN FORWARD POSITION	.250	1.200	45.000

REFERENCE INFORMATION

SREF	19.6350	SQ.IN.
LREF	5.0000	IN.
BREF	5.0000	IN.
XMRP	26.5000	IN.
YMRP	.0000	IN.
ZMRP	.0000	IN.
SCALE	.0000	

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